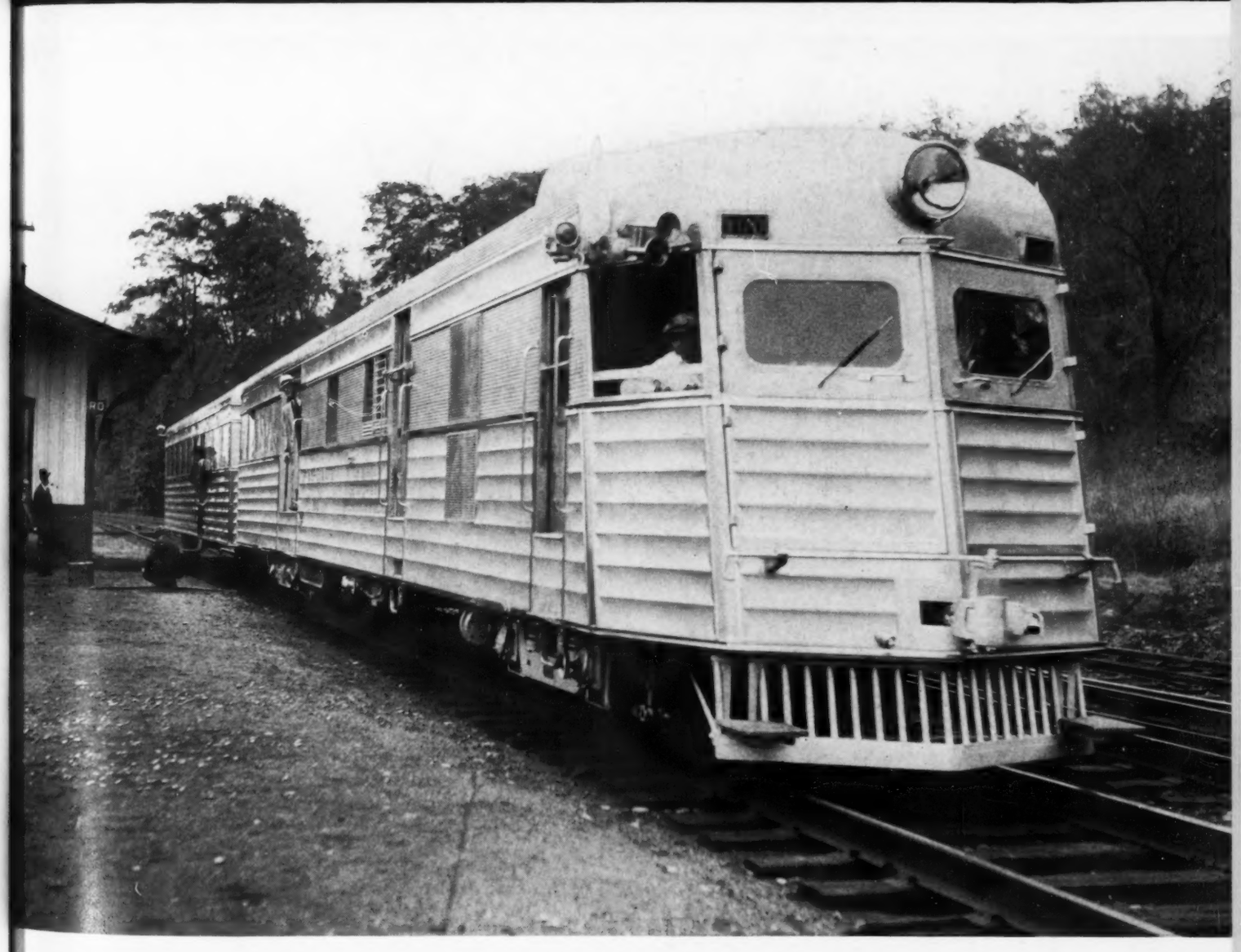
Engineering Library

15 cents per copy McGraw-Hill Publishing Company, Inc. FEB 5 FEBRUARY 3, 1934

ELECTRICAL WORLD



RAILROAD ELECTRIFICATION NEXT

New ideas in the railroad industry are conducive to rapid advances in electrification. The Pennsylvania announces a $70,000,000 expenditure on its New York-Washington electrification. Stream-lined trains introduce welded fabrication. The picture shows the Diesel-electric Budd-Westinghouse stream-lined train that was built by the new shot-welding process. The Union Pacific has a new stream-lined train. Both for power and incidental applications the railroads afford a large, new market for the electrical industry.

THEY USE RELIABLE WESTON *PHOTRONIC (PHOTO CELL) EQUIPMENT

Here are the most unique doors in any train terminal in this country. They open and close—automatically—several million times each month. Not a human hand touches them. A PHOTRONIC cell and a light beam are the sole activating source. What a comfort and convenience to travelers . . . what a help in facilitating movement of crowds.

In train terminals, as well as in other industrial and commercial activities where flawless operation is vital, *reliable* photo-cell control equipment must be used. And Weston PHOTRONIC equipment *is* reliable, because of the characteristics of the Weston cell, the simplicity of the circuit, and the ease of installing and maintaining PHOTRONIC control equipment.

Whether your problem is opening doors, counting, sorting, or controlling operations by color or density changes, Weston PHOTRONIC control should be considered. It is simple, reliable and economical. Its outstanding advantages are listed at the left. For further information write . . . Weston Electrical Instrument Corporation, 578 Frelinghuysen Avenue, Newark, N. J.

OUTSTANDING FEATURES

1. NO AUXILIARY POWER — PHOTRONIC (dry-type) cells transform light energy directly into electrical energy.
2. NO AMPLIFICATION—High current output of PHOTRONIC cells activate sensitive relays without complicated amplifiers.
3. UNLIMITED LIFE—PHOTRONIC cells do not deteriorate or wear out — deliver a constant output.
4. EASY TO INSTALL—PHOTRONIC equipment shipped ready to install and operate. Control box can be located remote from cell.
5. SPECTRAL RESPONSE—Like that of the human eye, PHOTRONIC cells accurately control by color and density changes.
6. LOW COST—The initial cost is low and maintenance practically negligible.

These doors, manufactured and installed in the Pennsylvania Terminal, New York City, by The Stanley Works, New Britain, Conn., are operated by Weston PHOTRONIC photo-cells and relays.

*PHOTRONIC—a registered trade-mark designating the photoelectric cells and photo electric devices manufactured exclusively by the Weston Electrical Instrument Corporation.

WESTON *Instruments*

ELECTRICAL WORLD

A consolidation of Electrical World, Electrical Engineer and American Electrician

What in the World!

A splendid A.I.E.E. convention. That was the general opinion of those fortunate enough to attend the meeting in New York last week. But best of all parts of the convention we liked the human values. The Sprague bust presentation and the Edison medal ceremony for Dr. Kennelly gave a touch of history, of personality and of inspiration. What modest mental giants these electrical pioneers were!

●

Most thrilling to the imagination, at least to a feature writer in the New York *Times*, was the demonstration of developments in sound transmission. By ears alone one got a depth perspective, a space perspective of performers on a distant stage. Does this new achievement render obsolete all present radios? Think of what this development, accompanied by an equally perfect television accomplishment, would mean to humanity. One could sit in a chair and yet have true sight and sound of anything or any place in the world. What a lazy man's world that would be.

●

Sometimes institute members take a selfish point of view and say, "What do we get for what we pay?" Those who ask this question miss the whole point of institute membership; they start with a wrong premise. Attendance at an institute convention changes this question to "What can I do to help the institute and the profession?"

●

This issue is a report of the institute meeting. It was made possible by a hard-working, competent editorial staff. We hope readers will find the values the editors found in this fine engineering meeting.

●

We were not above being quite pleased at the nice compliment one speaker paid us in commenting upon the value of our presentation of recent Gross and Turner stories of bushing testing experience and results on the American Gas & Electric system.

L. W. W. MORROW, Editor

E. R. SEARLES, Managing Editor · A. E. KNOWLTON, Associate Editor · G. F. WITTIG, Statistical Editor · EARL WHITEHORNE, Contributing Editor

FRANK R. INNES, Western Editor · C. W. LEIHY, Pacific Coast Editor · H. S. KNOWLTON, Contributing Editor · PAUL WOOTON, Washington Correspondent

JAMES H. RUDD
Publishing Director

February 3, 1934

Contents Copyrighted, 1934, by McGraw-Hill Publishing Company, Inc.

VOLUME 103 . . . NUMBER 5

Surges, Furnaces, Distribution, Features of A.I.E.E. Program 176

Advances in Protective Devices Improve Service 180
High-Speed Contacts Problems in Transportation... 181
Educators Discuss Developments 181
Better Breakers Sought as Service Aid..... 181
Counterpoise for Boulder Dam Line Grounding.... 182
Edison Medal Awarded to Dr. A. E. Kennelly..... 183
Lowest Distribution Costs Depend on System Used.. 184
Industrial Furnace Progress Awaits Standardization. 185
Rectifier Refinements Offer 85 per Cent Space Saving 186
What Tests for Bushings? Demand Meters Debated 186
Future for Auditory Perspective?..... 187

What Would Inflation Do to 1934 Kilowatt-Hours?..... 188

By GEORGE A. READ, Brooklyn Edison Company

Wiring of Machine Tools Needs Attention 195

By D. K. FROST, Mattison Machine Works

November Output Up; Revenue Down..... 194
News of This Week..... 198
Men of the Industry..... 207
New Equipment 208

Electrical World articles are indexed in Industrial Arts and Engineering Indexes, available in public libraries

ELECTRICAL WORLD—Published weekly, price 25 cents a copy. Subscription rates—United States, Mexico and Central and South American countries $5 a year. Canada, including duty, $7.50 a year. All other countries $9, or 36 shillings, a year. Entered as second-class matter January 20, 1907, at Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

Branch Offices: 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, Aldwych, London, W.C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Greenville, S. C.

Printed by The Schweinler Press, N. Y.

McGRAW-HILL PUBLISHING COMPANY, INC.

330 West 42d Street, New York, N. Y.

JAMES H. McGRAW, Chairman of the Board · MALCOLM MUIR, President
JAMES H. McGRAW, JR., Vice-Pres. and Treasurer · MASON BRITTON, Vice-President
EDGAR KOBAK, Vice-President · H. C. PARMELEE, Vice-President
HAROLD W. McGRAW, Vice-President · B. R. PUTNAM, Secretary

Cable address: MCGRAWHILL, New York. Member A.B.P. Member A.B.C.

NRA MEMBER U.S. WE DO OUR PART

Use OKOLITE INSULATION *for the tough places*

BECAUSE IT IS EFFECTIVELY RESISTANT TO

MOISTURE • CORONA • TEMPERATURE

OKOLITE insulation permits the use of HIGHER VOLTAGES—HIGHER LOADINGS.

Not requiring a lead sheath, it avoids the wiping of joints, the effects of electrolysis and corrosion, sheath losses, and other disadvantages of lead.

OKOLITE is a *DIFFERENT*, high-voltage cable insulation developed upon extensive research—and backed with an impressive performance record. More impervious to moisture, it has the resiliency and other desirable mechanical characteristics of rubber insulation. But it is effectively resistant to CORONA and HEAT.

OKOLITE insulation is suitable for many classes of power cable: Station—Aerial—Underground—Submarine—Industrial. Its scope runs from a small control wire to a heavy generator lead—or a submarine power cable.

OKOLITE insulation is particularly adaptable for braided cables in wet ducts—or where there are high temperatures.

THE OKONITE COMPANY

FOUNDED 1878

THE OKONITE-CALLENDER CABLE COMPANY, INC.
Factories: Passaic, N. J. Paterson, N. J.

SALES OFFICES:

NEW YORK CHICAGO SAN FRANCISCO PHILADELPHIA LOS ANGELES PITTSBURGH SEATTLE BOSTON DALLAS ATLANTA

Novelty Electric Co., Philadelphia, Pa.
The F. D. Lawrence Electric Co., Cincinnati, O.

Canadian Representatives
Engineering Materials, Limited, Montreal

Cuban Representatives
Victor G. Mendoza Co., Havana

OKONITE QUALITY CANNOT BE WRITTEN INTO A SPECIFICATION

ELECTRICAL WORLD

Established 1883—McGraw-Hill Publishing Company, Inc.

for the Week Ending

February 3, 1934

L. W. W. MORROW, *Editor*

New Conceptions for the A.I.E.E.

ELECTRICAL engineers are confronting new conditions. They are finding their work affected by the revolutionary actions and thoughts that characterize the present period. This was manifest in the program of the American Institute of Electrical Engineers held last week in New York.

The meeting was more practical and less technical than usual and the symposiums called forth discussions wherein economic merit was the basis of the engineering comments. This meeting was disappointing in the lack of presentation of papers on new theory, new science or new engineering developments, but from the point of view that the engineer has come to weigh economic values, the program was constructive. In all industry and in the several utilities there are enormous assemblies of technical apparatus that must function to give service and to produce profits. It is inevitable, therefore, that engineering problems connected with the installation and operation of these assemblies must be solved to give economic and service results and that one of several solutions can be had for each problem. In a sense, these problems are economic and practical and bring in technical considerations only as underlying influences. They all reduce to the question, what does this installation or design cost and what grade of service does it render in comparison to alternative installations or designs? At the institute meeting last week this question predominated and yet was disguised and stated indirectly too frequently lest it be said that the program was not technical.

It is high time to face the fact that engineers must meet an economic and service evaluation of all their accomplishments and the institute must become a forum for the discussion of these types of papers. It must also continue to present and discuss the new theories and the new developments that have not yet come into practical application. This has been its chief function in the past, but it must now change with changed conditions if it is to realize its full responsibility.

In fact, it must be admitted that the institute must go further than even economic considerations in engineering and devise a way to present papers and have discussions on engineering problems whose solution affects our social as well as our economic well being. It is becoming increasingly evident that all engineering projects must be in the public interest if they are to be valuable to humanity, and professional engineering societies should follow this broad conception in formulating their policies. They should discuss engineering developments from this point of view and they should also make their opinions and conclusions known to the general public. They must take the position that they are consultants for the public because they are competent and, in addition, become spokesmen for the engineers because they can give informed opinions that will aid in arriving at intelligent national decisions.

This principle is difficult to put into practical operation in the societies. There must be control so that papers and discussions are held

within realms wherein engineers are competent. There must be control so that the problems discussed can be divorced from political considerations and reduced to the essential engineering and economic elements that permit them to be judged from the point of view of the public interest only. Yet despite the difficulties that can be expected, it is necessary that professional societies such as the A.I.E.E. embark upon programs that will embody these conceptions of the engineer.

It is in this new realm of activity that the midwinter meeting of the institute gave promise of growth and of service. No professional society has a greater service opportunity than the institute at this time and we hope it will act wisely and promptly in this fiftieth anniversary year to develop the idea of social engineering as well as technical engineering.

Bureau standardization must be supported

Congress may, in its petty penury, easily leave the people ohmless and the nation's industries almost wattless. The Bureau of Standards has been cut so drastically that the continued maintenance of the fundamental electrical standards is in hazard. No one will now bring up the propriety or nonpropriety of the government re-engaging in the commercial standardization which has largely been assumed by industry through the American Standards Association. That is a totally independent question. The present question pertains to a threat which may endanger the results of several decades of intensified precision work in laying the foundation for the whole electrical art through maintenance of its units of measure.

It is comparatively easy to store a yardstick or a standard pound while the bureau experts go on an enforced vacation. The volt and the ohm are a different breed of physical, semi-tangible standards. Only by unremittingly "keeping at it" and cross-checking with the European governmental laboratories can these standards be deterred from drifting into decays, slight perhaps in themselves, but ruinous of accuracies in the electrical arts, where decimal places are more respected than in any other art involving measurement. The bureau was established to do this fundamental standardization, and it has done it well. The profession should support the bureau in its time of trial, even to the degree of writing congressmen about the importance of this standardization.

The contractor as an industry problem

It has long been a custom in the electrical industry to point the critical finger at the contractor. He has been blamed for the inadequacy of wiring installations. He has been blamed for the cost of wiring. He has been blamed because he has not done a better selling job and because he is not prosperous.

The power company men, the manufacturers and the wholesalers have all stood off and gazed at him from afar. They have analyzed his weaknesses and his trouble. Together they have discussed him as a problem. They have even tried to help him at times. But they have never yet quite awakened to the fact that he is a vitally important member of the electrical family and a major factor in their own affairs. They have missed the point—that so long as the contractor is ill nourished and neglected in the family there will be sickness in the home affecting all.

The contractor has occupied the unhappy position of the redheaded stepchild, who is ignored and imposed upon by the rest of the household. He has chopped the wood and fetched the water and done the lowly chores. But he has wired some 20,000,000 homes and some 4,000,000 stores and factories over a period of years. He has prepared the way for the industry's customers to use its services and products. He has bought from everybody and labored everywhere, and without his work there would be no electrical industry.

This man and his function are vital to all branches of the electrical business. His prosperity and progress advance the art and expand the industry. Impoverish and obstruct him and all suffer. For when the manufacturer gives away engineering and consulting service and makes it impossible for him to sell his own experience and facilities, and when the wholesaler subsidizes incompetent competitors that prey upon him and cut prices, and when the power company sets up a range wiring schedule that only the "curbstoner" can meet—the contractor falters and his work is crippled.

Other electrical men have the habit of talking impersonally about the contractor. It can-

not be done—within the electrical family. Wiring must function or good health among us is impossible. The contractor's problem is an industry problem.

Stimulating industrial power-factor correction

Industrial power-factor correction is a specialized engineering task. The conditions of the problem are none too easy for the industrial executive to visualize, unless his background is electrical. He is prone to regard penalty clauses in power rates as a species of racket unless he senses the waste involved in low power factor and sees tangible advantages to himself in spending hard-earned money for correction. As a rule, the drawbacks of poor power factor must be translated into dollar costs before much headway can be made in selling the idea of improvement to manufacturing plants. In such work the utility power sales department is in a position to offer aid, which, though not philanthropic, is designed to bring about better conditions for both customer and company.

Co-operation of this kind is the basis of corrective work in Rhode Island, where the Blackstone Valley Gas & Electric Company has been the cause of installing more than 4,000 kva. in capacitors in diversified industrial plants in recent months. The company has financed corrective equipment when necessary; established a power-factor charge graduated from 80 per cent down to 60 per cent lagging; continued to pay a bonus for improvement above the base; credited local contractors with commissions, according them wiring and installation jobs, and advised its industrial customers on corrective problems. The industrial sales department has capitalized its continuing contacts with the mills in convincing their managements that corrective measures should be taken and that benefits to all concerned will result. Leading power customers have a summated demand of more than 42,000 kw. and pay about $500,000 a year in demand charges.

As a result of this work penalties for low power factor have been cut down by $15,000 a year; voltage regulation has been improved on internal industrial feeders, and more than 3,100 kva. in transformer capacity has been released for future service. Thus far the work has been confined to installations of 50 kw. demand or above, but it is progressing steadily and indicates what can be done even by a comparatively small company with a power sales department in close phase with its customers' conditions and thinking. The shortening of hours in manufacturing plants under the NRA has put a premium upon the intensive use of plant; competition for net profit is acute, and this form of industrial modernization deserves wider consideration by many factories and power companies.

Practical aspects of a national power scheme

Wealth of literature on the theory of fault computations may easily give the impression that relatively little actual computing has to be done after the initial system set-up. Those who still talk glibly of nation-wide hook-ups from the St. Lawrence to Tennessee and Boulder and Columbia Basin must have jumped at the conclusion that a slide rule and a flock of A.I.E.E. papers at hand make any voltage, any distance and any intricacy of interconnection with load area systems physically and economically practicable.

Actually, however, system operators are not secure in their day-to-day administration of their systems unless others make for them literally hundreds of intricate and difficult computations. Every different loading, every different combination of available power resources and of lines to pass on their outputs makes for a different potentiality of losses, faults and interruptions. The protective devices have to be more than human to act quickly and intelligently under such a multiplicity of varying combinations. Even with their miraculous performance in helping the systems to ride through all kinds of disturbances they nevertheless fall a bit short of perfection on today's systems of relatively limited magnitude.

These limitations have done their share to restrict the systems to a lesser area of interconnected operation than was freely mapped out a few years ago. Economics did the rest of the curtailment. But those who wink at the economics might give heed to the highly competent analytical staffs it requires behind the scenes to build these systems right and protect them properly against interruption by keeping "infernally at it" all the time to see that every fault contingency has been anticipated and plans made to circumvent it.

Surges, Furnaces, Distribution Features of A.I.E.E. Program

OF BROADEST interest on the recent winter meeting program of the American Institute of Electrical Engineers were the groups of papers which centered around the topics of electric melting furnaces, economic merits of distribution schemes, surge generation and measurement, the perennial subject of lightning and how to thwart it, and how to switch systems and protect them against instability. Newest and least rigorously established among these topics is undoubtedly that of the laboratory simulation of lightning and the problems of measuring and applying the generated impulses. The next wave of standardization for electrical systems is that of rating equipment in terms of its vulnerability to and proof against lightning surges. Co-ordination of system insulation is taking that direction and the first moves have already been taken to give transformer windings, bushings, gaps and arresters an impulse rating that will be independent of, but co-ordinated with, the power frequency ratings as to insulation quality.

Before equipment designs can be molded to the point where standards of impulse ratings can be established there must be a high degree of acceptance of the equipment devised with which to conduct the tests. J. L. Thomason in his paper breaks the test set-up into four components—the impulse generator, the wave-control element, the test specimen and the measuring circuit. This is too complicated an assembly for rigorous solution unless reduced to simplified form. The author then proceeds to add successive elements to simulate the various test loads and compensating components of the circuit and thereby ascertain the Bush operators to insert in the Heaviside solution. The paper substantiates the cathode-ray oscillogram records of the impulse voltages applied to the test pieces.

High impulse currents are necessary as well as high impulse voltages in order to simulate all the puncture and explosive effects of lightning impulses. The Westinghouse 3,000,000-volt surge generator at Sharon gives only about 20,000 amp. maximum, says P. L. Bellaschi, and this applies to a 5-microsecond oscillatory wave. Higher currents demand lower internal impedances in the generator and this can be effected by connecting the capacitor groups in parallel, thus affording 75,000 amp. discharge capacity. By using an adjunct surge generator the amperes have been brought above 100,000. Currents up to 65,000 amp. have been measured through the medium of non-inductive shunts consisting, in one case, of six 12-in. lengths of No. 20 manganin in parallel (0.0436 ohm). Field tests on natural lighting and laboratory tests with the surge current generators show that lightning currents are not likely to fuse No. 10 copper, but do often fuse No. 14. (Fig. 1.)

Meanwhile the prevention of lightning damage continues to get its share of theorizing and of practical adaptations while the measurement of its man-made equivalents is being perfected. The counterpoise is gaining favor and C. L. Fortescue makes a strong case for the type which has its buried conductors extending from each tower parallel to the line conductors as contrasted with the crowfoot or radial type. Both aim to correct for inherently high tower footing resistances, the latter only by injecting enough earth capacitance to help lower the surge impedance of the tower legs. The parallel type in addition reduces by mutual coupling the difference of potential between line conductors and the tower top. Fortescue presents a mathematical analysis to support his contention for the parallel type on this basis. For very high earth resistances he advocates carrying the parallel counterpoise wires continuously from tower to tower. Further than that, he sets up 10 ohms as the value to aim at in designing the line, whether by driven grounds or composite counterpoises.

Experience in Pennsylvania is cited to support argument for parallel counterpoises. Two and one-half miles of it along a high peak stopped all insulator flashovers, while 22½ miles of crowfoot counterpoises showed five such flashovers in the same four years. It is also pointed out in the paper that d.c. measurements give too low a value of ground impedances because they ignore the higher transitory impedances that prevail during the exponential rise of current to its sustained value. On the other hand, it is conjectured that parallel counterpoises may be more effective as low surge impedances than d.c. measurements of them might indicate. Surge admittance of two parallel wires 40 ft. apart is calculated to be the same as four wires of the same length radiating out at 45 deg. to the line.

Lightning studied on distribution system

Application of 100 surge voltage recorders on the 4-kv. distribution system of the Commonwealth Edison Company in Chicago has thrown new light on the magnitude of lightning currents and voltages on the lower voltage circuits comparable in significance to that already well established for transmission systems. Known direct strokes were negative and the maximum was 488 kv.; with no evidence of flashover the voltages were 300 kv. or less in open territory. The probability that high lightning voltages may occur at transformer locations on long circuits is ten to twenty times as great as for urban circuits, according to the authors, Herman Halperin and K. B. McEachron. Nevertheless the probability of direct strokes is remote. Surge cloud discharges seem to cover 1,000 to 3,000 ft. of the line where equipment is separated

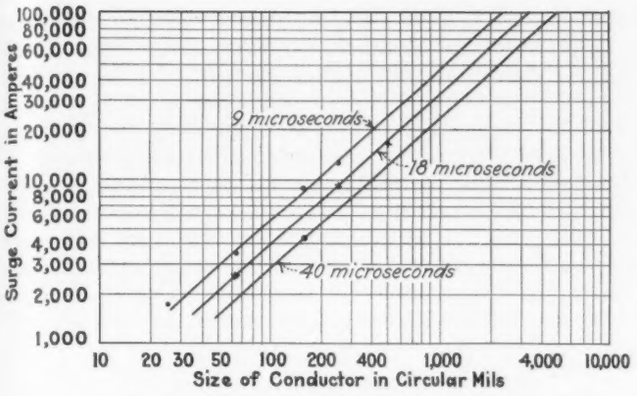


Fig. 1—Fusion characteristics of copper conductors with surge currents

Steep front surges with exponential tails of various wave front durations (Bellaschi paper)

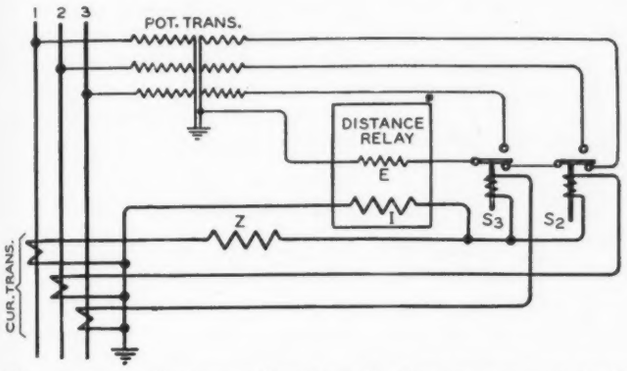


Fig. 2—One distance relay for all phase-to-ground faults

Selector relays (S_2, S_3) shift potential to faulted phase. Dummy impedance **Z** balances current transformer burdens.

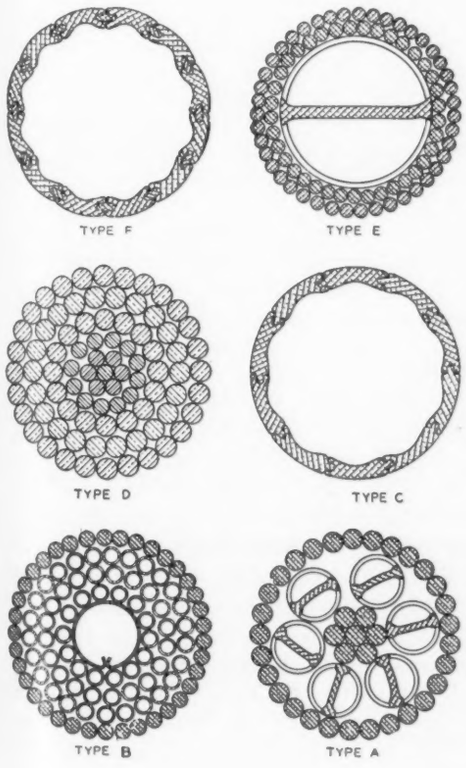


Fig. 5—Types of conductors tested for corona loss on Boulder line

(A) Copper; seven-strand core, six twisted I-beams and single layer of 30 wires each 0.125 in. diameter with 11-in. R.H. lay.

(B) Copper; central tube surrounded by three layers of small tubes. Outside layer consists of 37 solid round 0.104-in. wires on 14-in. L.H. lay.

(C) Copper: ten segments (interlocked) on 28-in. R.H. lay.

(D) A.C.S.R.; outside is 28 strands 0.1355-in. aluminum with 14.5-in. L.H. lay.

(E) Copper; twisted I-beam with two layers of round wires, the outer being 37 wires of 0.1077-in. diameter on a 10.9-in. R.H. lay.

(F) Copper; twelve segments on 19-in. R.H. lay; seams "submerged" by making segment curvature more than normal conductor radius.

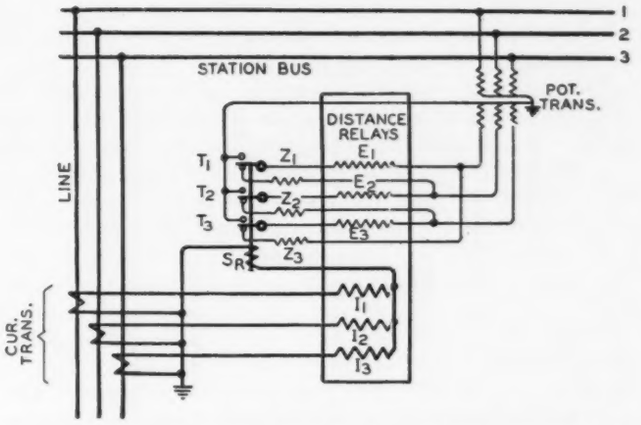


Fig. 3—Three distance relays for interphase ground faults

Selector relay actuated by residual currents shifts potential from delta to wye voltages.

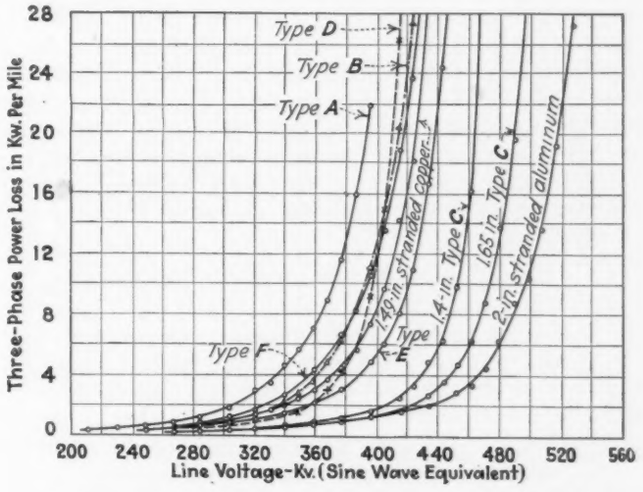


Fig. 4—Cleaned segmented conductor has lowest corona loss of all 1.4-in. conductors tested

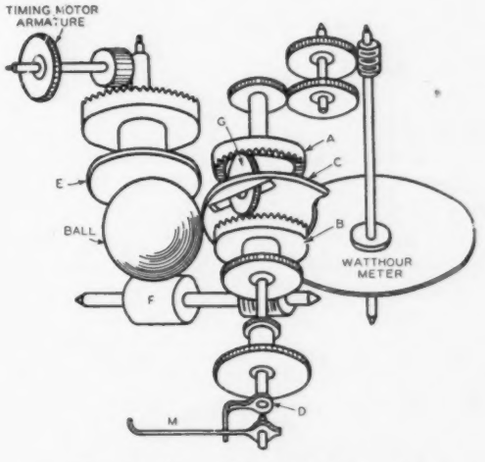


Fig. 6—New Demand meter has logarithmic response

Involute cam (C) on plantary gear (G) of differential (AB) places ball at disk (E) radius appropriate to load and ball, then drives cylinder (F), which rotates differential gear (B). Pusher arm (D) is on shaft of cam (C).

by relatively large distances. In urban territory this fact of equipment spacing appears to hold the voltages to considerably less than 200 kv.

Arresters materially reduce the lightning voltages at transformers and a 300-amp. discharge capacity is indicated. With the interconnected arrester ground and neutral main only the arrester potential appears between the primary coil and the secondary neutral main. For equal lightning voltages the insulation of transformers with such interconnection is stressed considerably less than that of transformers with conventional arrester protection.

The Chicago system is four-wire, $2\frac{3}{4}$ kv. with neutral grounded at the substations at which the cables originate. A 3,000-volt and 300-volt arrester are on the same pole with each single-phase lightning transformer. For three transformer installations the arresters are three 3,000-volt and one 300-volt, but not more than one such group per block. At cable risers an arrester was installed on each primary wire. In 160 storms during three years 1,017 fuses were blown and 402 transformers burned out. There were 311 records obtained from 1,883 pairs of surge recorder films installed. Of these 308 were positive and 130 were in the 3 to 10 kv. range and 76 in the 11 to 25 kv. range, with only three over 350 kv., and these were on the long circuits. Sixty-four of the recorders were allocated to eight transformer poles so as to get the division of the surge among elements of a transformer installation. Two 1,600-ft. circuits showed that the maximum voltages did not exist within the end quarter sections.

Surge impedance of machines analyzed

Reverting to the higher potential systems, a paper by J. F. Calvert analyzed the protection against surges of the armatures of rotating equipments. Graded insulation is desirable for the higher voltage generators and condensers, but the machines should have solidly grounded neutral, and at the approximate middle of the winding there should be an arrester tapped to ground. The author believes it unlikely that the European form of concentric wiring for 33-kv. generators will be favored here, because it has economic drawbacks in fabrication, assembly and coil replacement. It does, however, offer the protective advantage that whatever is done to protect the ground insulation will adequately protect the turn insulation.

On machines with uniform ground insulation it can be protected by lightning arresters regardless of the surge steepness and duration. In conventional rectangular coil machines the turn insulation can be protected by sloping off the incoming wave. Lightning arresters should be used to limit to the 60-cycle crest value of insulation test voltage the crest value of surges that may reach the machine armatures.

Several methods have been devised for measuring the surge impedances of machines. The results they give are consistent with one another, but are considerably below those cited by earlier authors. It seems a bit early to generalize on the magnitudes of surge impedances in relation to their power-frequency impedances. These tests on a 25,000-kva. synchronous condenser did show, however, that saturation and coupling between phases have small effect; nor did the presence or absence of the rotor or its angular position have anywhere near as much effect as did the various connections tried for the armature winding.

Clearing line faults is greatly facilitated by the two Petersen coils installed on the major portion of the 140-kv. Consumers Power system in Michigan, the first in the country above 100 kv. Both are General Electric built and rated 10,773 kva., protected by thyrite resistors. Nine taps provide for tuning to values between 2.38 + j515 and 4.46 + j1,482 ohms. For sustained faults, which they cannot clear, they are shorted out by a relay. They have been in continuous service since February, 1932, with an automatic oscillograph and curve-drawing ammeter to record their performance. Out of 85 lightning and sixteen other faults the coils cleared 74 per cent without an interruption of the lines. They cleared without interruption 96 per cent of the ground faults.

Only one fault that started as a ground fault failed to clear before it grew into a short circuit. Most of the faults were cleared in less than five cycles. In this paper by Messrs. North and Eaton it is reported that shocks to the system are less under ground faults than with isolated neutral or neutral grounded through high impendance. The tuned and compensated fault current is kept small regardless of the distance of the fault or the conductor on which it happens. Above all, the installation of the Petersen coils does not affect or handicap the normal routine of system operation except for the tap changes that are necessitated by changes in the interconnected lengths of the lines.

One relay can do work of several

While distance relays have found growing application on systems of 100 kv. or above to protect against multiphase faults the costs have prevented more extended application. A. C. VanR. Warrington shows how automatic switching of the potential connections can make each distance relay installation do the work of two or three, as is already being done in Europe. A single relay can protect against interphase and ground faults, although the switching of the potential connections can become complicated in this case. Thus, a ground distance relay can be multiplied in effectiveness by the simple switching scheme of Fig. 2. A fault in another phase than that which normally supplies potential to the relay shifts the potential connections to that phase through contacts actuated by overcurrent in that other phase. Similarly, a three-relay interphase-fault installation can be extended to cover single-phase ground faults by means of the switching of Fig. 3.

Corona loss control dictated the adoption of a 1.4-in. diameter for the Los Angeles Department of Water and Power's new 275-kv. line from Boulder Dam to the city. Studies have been conducted on 700-ft. samples of six different designs of conductors and it was concluded that the differences in corona loss favor the segmental shell conductor in preference to any of the stranded conductors. This is true after either mere water washing or washing with gasoline, soap and water to remove die greases which otherwise prevent getting consistent results. (See Figs. 4 and 5.)

Electric melting proving itself in performance

Quicker melt has been obtained in steel melting arc furnaces by increasing the transformer capacities and thus shortening the radiation loss period, but limiting values are being found due to the economic effect of demand charges. This is forcing a new attack on furnace efficiencies, says Samuel Arnold, 3d, in his paper. Refractory and metallurgical problems are created with the

high rate inputs because intense local heating shortens the life of the insulation or affects the structure of the melt adversely. In spite of these problems electric furnaces have made great strides for gray iron, tool steels and stainless steels, even during the depression.

As contrasted with the open-hearth type the investment costs are usually less and the operating costs, outside of electrical energy, no greater. Energy at 6 mills shows a cost of about $4.50 per ton for current and electrode consumption, as against $1 per ton for open-hearth fuel costs. The $3.50 differential is often more than offset by lower carrying charges on furnace and auxiliaries, increased yield and higher-priced higher quality of product.

The aluminum industry uses by far the largest percentage of the electrodes consumed in the furnace industry, a ton of aluminum entailing a consumption of about 1,500 lb. of carbon electrode. Steel casting takes only from 9 to 20 lb. per ton; the non-ferrous and iron casting metals use graphite electrodes and to the extent of 2.5 to 14 lb. per ton of product. Altogether there are 580 ferrous and 560 non-ferrous furnaces in operation (excluding the induction type). Electric melt produced 141,000 tons of ingot and 100,000 tons of steel castings in the United States in 1932. The corresponding figures for 1930 were 307,000 tons of ingots and 305,000 tons of castings. These figures are cited in the paper by F. J. Vosburgh.

M. V. Healey's contribution is authority for the statement that cast iron of any carbon content from 1.7 to 3.6 per cent can be produced readily and accurately in the electric furnace. The cupola begins above 3 per cent, but with it it is impossible to dissolve the suspension of carbon, and as a consequence the iron is coarse grained and non-uniform. The superheating possible in the electric furnace makes the difference. No great cost differential exists, the author estimating $16.43 per ton by cupola (with coke at $10 per ton) and $16.53 electrically with kilowatt-hours at 1 cent, electrodes at 8 lb. per ton and 10 cents per pound. The excess cost of $5.71 for energy is just about offset by the lessened (by $5.61) cost of the cheaper scrap for charging. Electric melting shows its superiority primarily in the precise quality of the product and the ability to use up scrap.

Indirect arcs in rocking furnaces are so stable, according to E. L. Crosby, that many operators are now gaging the temperature of the melt by the energy input, especially where the kilowatt-hour schedule is charted in conformity with good past performance. The pyrometer then becomes merely a checking device. This temperature control is so precise that the cast-iron product is of such positive quality as to have caused a reversion to it for automotive crankshafts and camshafts. The results with the thousands of cars so equipped are stimulating the replacement of many steel-forged and steel-cast parts by the superior cast iron from the electric furnace. Unalloyed unheat-treated gray iron is being electrically produced with such texture as to show 45,000 to 50,000 lb. per square inch tensile strength and transverse strength correspondingly improved. Heat treatment easily brings these cast products up to 110,000 lb. tensile strength with remarkable shock and fatigue behavior.

Induction furnaces for high-grade products

For high-frequency melting equipments the costs are roughly four times as great as for arc-melting equipment on a comparative daily tonnage basis, but this gives a poor picture of the relative merits. In their paper on induction furnaces Messrs. Adams, Hodge and McKusick point to the reduced space for mold capacity, the reduced outlay for ingot molds and the lesser crane and hoist investment with induction melting installation. Another authority (D. F. Campbell) is quoted by them as stating that, for a steel works capacity of 6,000 tons per week, the capital cost of induction-melting equipment would be less than with open-hearth furnaces.

Electrode consumption more than balances the lesser energy cost of arc-melting equipment. Moreover, the arc furnace load is less desirable on a demand basis than a synchronous motor driving the high-frequency generator used with the induction furnace. The power factor of the load is better, even though the power factor of the high-frequency (usually 960 cycles) itself may be in the 15 per cent range until compensated by the relatively small capacitors that are paralleled with it to permit economic size of the high-frequency generator. Based upon an approximate monthly production of 200 tons melted in 3,000-lb. and 1,500-lb. furnaces using a 1,250-kva. generator, the cost of acid furnace linings in one plant is approximately $1.30 per ton of product. On the same tonnage basis the cost of maintenance for the entire melting equipment, exclusive of furnace linings, is about $0.90 per ton. For smaller melting units or for a smaller tonnage these figures would, of course, be higher. Continuity of production with induction melting usually is maintained by having a spare furnace on hand so that lining repairs may be made without loss of time. The cost of a spare unit adds only about 5 per cent to the original investment.

Primary network combined with radial expansion

Studies made in Boston, Chicago and Buffalo under specific conditions of specific areas indicate that the primary network was not the most feasible system to employ on an extensive scale in revamping and enlarging the distribution facilities of those areas. A. H. Sweetnam and C. A. Corney report in their paper that the Edison company of Boston will provide initially for the relief of the existing substation of the Somerville area by installing network transformers to supply three radial circuits. When increasing load justifies it a second two-transformer bank will be installed at an adjacent load center and two of its radial circuits will be so arranged as to permit interconnection with two of the circuits of the original unit if found practicable. The area in question is 4 square miles and has about 9,000 kva. load served by nine 4-kv., four-wire lighting feeders and four three-wire power feeders. All of seven schemes were compared with the one involving abandonment of the present 8,000-kva. substation and building of a new 12,000-kva. station. The scheme chosen costs only 12.9 per cent as much as the new 12,000-kva. station and makes a beginning on a primary network. To have maintained the present substation and begun a network with four single-transformer units would have cost 39.4 per cent as much as a wholly new radial substation. For the ultimate capacities of 20,000 to 23,000 kva. gradual building up to four two-transformer network units would cost only 42.7 per cent of what a new substation would have cost. The annual costs are also least for the plan of beginning the network on a conservative basis.

In the Chicago study a residential area of 6.25 square

miles with a population density of 10,000 per square mile and a load density of 1,000 kva. per square mile was taken. H. E. Wulfing concludes that extension of the radial system is more economical than the primary network. The additional cost of the network does not appear to equal the value of the slightly better service continuity which it may afford. New investment up to 1939 for the 4-kv. radial would be $841,850, as against $1,057,130 for a 4-kv. network. Annual cost on the net additional investment in the ten years 1930-39 would be $509,900 for the radial system and $550,600 for the network.

Among the few new developments reported in the papers is a Westinghouse demand meter which has a mechanical characteristic similar to the thermal demand meter. As shown in Fig. 6 a ball, disk and cylinder in conjunction with an involute cam attached to the planetary gear of a differential give the meter a logarithmic or exponential performance practically the same as that of the thermal storage meter. It has no trip mechanism, the pusher arm assuming a position corresponding to the load at the instant and to what has preceded. Having no arbitrarily fixed time interval it cannot split the peaks.

Advances in Protective Devices Lead to Improved Service

EXPERIENCES and valid data on the use of the Petersen coil were presented in a paper at the session on protective devices. These coils were used on the 140-kv. system of the Consumers Power Company and operating experiences with the coils indicate their value in limiting or preventing fault interruptions to service on an ungrounded neutral transmission system. It was found advisable in later tests to use a compensating transformer in the Petersen coil circuit so as to compensate for the current produced by losses and by corona effects. J. M. Dunham discussed the current distribution in the lines and in the earth with and without the use of Petersen coils. C. L. Fortescue stated that great improvements had been had in protecting lines by use of overhead ground wires and adequate grounding systems. The Petersen coil does not protect substation apparatus and will not protect a line better than the protection obtained by other methods, but it undoubtedly will reduce outages and there is a field for it. Its chief use at present has been in Germany, where lightning disturbances are not so severe as in this country. In general, the use of the Petersen coil involves an economic analysis to determine the relative cost of this form of protection and of that available in other forms. The rapid improvement and increasing use of high-speed circuit breakers appreciably affect this economic equation. Other discussions indicated that the Petersen coil has a field of application for use on existing lines that have not already installed other types of protection. It was also pointed out that the Petersen coil will remove arcing grounds and thus prevent building up of potential; also, the effect of unbalanced capacity might give an appreciable residual current, which would flow continuously, and therefore Petersen coils must be designed with adequate thermal capacity.

An interesting paper covering field investigations of lightning on 4-kv. overhead circuits in Chicago was presented. The data indicated that in general the voltage values were less than 200 kv. and the voltages found were predominantly negative. The long distribution circuits had higher values than the short links in the congested areas and the interconnection of grounds had appreciable advantages over the usual type of separate ground connections. The authors stated that the data were not yet conclusive and advocated continuation of the investigation. J. K. Hodnett stated that surge currents of 300 amp. or less and surge volts of 200 kv. or less are to be expected in the semi-shielded metropolitan distribution areas, but that in distribution for villages and other rural territories several years' experience indicated that surge currents of 10,000 amp. occurred relatively often. Field data also indicated that about one-half of 1 per cent of distribution transformers are subjected to very high surge voltages. C. L. Fortescue stated that the theory of probability indicated that on a half-mile section of line there would only be one direct stroke of lightning in seven years at 2,000 kv. and at 20,000 kv. value and higher the probability is only 0.003 per year. Yet these frequently encountered heavy strokes are the cause of line and apparatus damage. It also should be noted particularly that the voltage values obtained on a line depend on the footing resistance of the line. This in Chicago is about 25 ohms, while the national average is nearer 100 ohms. These opinions indicated that a study of three or four years on a given distribution system might not give data that would check the probability values or induce the very heavy surges that might be expected infrequently. He urged that these field investigations be continued. K. B. McEachron, one of the authors, in closing, stated that the protection of distribution systems from direct strokes is an economic question and that a study is needed of the probabilities of direct strokes. Available data seemed to indicate that one out of 10,000 transformers per year will be affected seriously by direct strokes of lightning.

An interesting paper on improvements and possible applications of distance relaying was presented by A. R. Van C. Warrington. The author pointed out that it might be possible, in the use of distance relays, to make one relay do the customary work of three relays by using selector switches to apply the proper fault current and voltage for relay operation rather than to use separate and complete relays. If this principle is applied, it seems possible to save from 35 to 50 per cent on relay costs, and the only disadvantage is a slight time delay induced by the operation of the selective voltage relays.

Automatic reclosing to the fore

RAPID advances in the use of automatically reclosing breakers and fuses are taking place. Data indicate such breakers to be very effective in limiting service interruptions. One paper showed the modifications necessary to relays and to customers' equipment to utilize this principle. In discussing the paper Robert Treat stated that nine times out of ten instantaneous reclosing breakers operate satisfactorily and eliminate corresponding interruptions. In his opinion, however, instantaneous reclosing is not a panacea for all interruptions, even though it has a wide field of application. Each specific case must be considered very carefully, even to the degree of analyzing and possibly changing customers' equip-

ments. H. P. Sleeper also stated that while the reclosing principle was good it could not be applied indiscriminately. A detailed survey should be made of the customer and his equipment as well as of the utility supply system. Also, the arrangements of the transformer and their fusing affect the application, because when heavy fusing is practiced, such as occurs with bank transformers, there may be trouble in using instantaneous reclosure while the fuses clear. In his opinion it should also be possible to substitute time-delay relays for instantaneous relays, and this practice in itself should eliminate about 80 per cent of present trip-outs. A second element that creates a problem is the method of handling modifications of customers' equipment and of customers' operating methods. W. S. Edsall outlined historical developments of the reclosing principle as applied to circuit breakers.

Catenary Contacts at High Speeds Offer Problem in Transportation

CURRENT collection from contact systems has risen to well over 2,000 amp., although, as recounted by N. W. Storer, 200 amp. looked like an upper limit in the early days of railroad electrification at the higher voltages. The demand for higher speeds and economical maintenance of the catenary and pantograph is creating new problems and emphasizing new aspects of partially solved old problems. Commenting on J. V. Lamson's paper on lubrication of the wire, Reinier Beeuwkes of the C., M. & St. P. road gave assurance that the relative merits of soft and hard graphitic lubricants would be studied in the tests still being conducted. D. H. Moore (Ohio Brass) urged that consideration be given to developing properties of lubricants to meet the wet and frosty condition of the wire as well as the dry condition. In place of the C., M. & St. P. practice of using a separate lubricating shoe between the two contact shoes, H. F. Brown of the New Haven road prefers, for its higher speeds, to lubricate the wire independently of the pantograph; he reported that data of trolley wear under this practice are being accumulated. He suggested the possibility of spraying the wire with oil at regular maintenance intervals. In the opinion of W. H. Bassett (American Brass) the true ultimate objective of lubrication should be to burnish the wire to a commutator glaze because tests have indicated that a wire that is made and kept smooth will give minimum wear of both electrical and mechanical origin, especially if the pantograph is also kept smooth.

Mr. Brown pointed out that the desirable uniform pressure of pantograph against the trolley wire is incompatible with the provision of accelerating force adequate to accommodate the pantograph level fast enough at higher train speeds to the varying level of the wire. He urged the adoption of an American standard for wire elevation and recommended the value of 22 ft. This will help simplify the task of co-ordinating the design of the contact and catenary system with that of the pantograph so as to alleviate the problem of pan and wire wear and maintenance.

Studies of rail impedance by Messrs. Trueblood and Wascheck were aimed at developing an equivalent circle to replace the irregular cross-section of the rail. This helps the segregation of internal from external reactance values. The authors assured their questioners that the proximity of the second rail in parallel at gage distance does not affect the results of impedance as found by this method.

Educators Discuss Developments

TUESDAY morning a session was held under the auspices of the institute committee on education. A brief abstract of the current activities of the committee and all student branch actions was given by Chairman L. A. Doggett. An interesting paper was delivered on the co-operative courses given by the University of Pittsburgh and the Westinghouse company. J. W. Barker of Columbia outlined the developments of the Engineering Council for Professional Development.

In discussing these papers, A. M. Dudley stated that a large percentage of engineering students of high mentality desire to take graduate work and that the arrangement in Pittsburgh satisfies this demand admirably and in addition makes a very desirable contact between industry and education. D. C. Jackson, Jr., stated that in the South and in the far West many conditions were radically different from those in the congested Eastern areas and that any plans of co-operation with industry or for graduate work in engineering in co-operation with industry had to take into consideration the great distance factors and the lack of industry in these areas. It is possible to do something along the lines indicated, but generalization should not be made about the national situation without giving due consideration to these sparsely settled areas. W. H. Timbie stated that the principle of a co-operative course between an industry and an educational institution was being applied in several ways in different parts of the country. In general, the experience indicates that the detail of the plan must be adapted to the local situation, but apparently the best results are obtained if the educational institution cooperates with one large company which is sufficiently comprehensive to focus the industrial aspect of the educational program.

Better High-Power Breakers Sought as Service Aid

REPLETE with stimulating ideas was the session on electric power switching. Some of the notable stations presented were Hudson Avenue, Richmond, Long Beach, Connors Creek and State Line. Authors described the switching schemes used, the systems in which the stations operate and gave reasons for the layouts installed. An active discussion was had on these papers. F. H. Hollister, in discussing the papers, said that in his opinion the future will see more use of generators and step-up transformers handled as units with busing at high voltage. These results will be forced by economic and service considerations. In his opinion there will be more high-tension transmission terminals located at load centers of distribution and there will be greater simplicity in power station switching arrangements. There should be more use of power stations as power stations alone and there should be elimination of low-

voltage switching at power stations. There is a trend toward the use of higher voltage generation and distribution at this voltage and the present limit of about 16,000 will more nearly approach the 33,000 to 36,000 volts used in England. In his opinion there is a demand for better circuit breakers and switching facilities. He stated that the present circuit breakers are a weak link and that circuit breaker designers are just keeping pace with the demands and are not anticipating them. C. H. Sanderson stated that the five stations described were the product of dissimilar specifications, which is understandable, because there are so many ways to arrive at a satisfactory solution.

It was apparent to him, however, that the group or sectionalized principle of operation has displaced the ring bus idea. In his opinion some better insulation than porcelain is needed and the use of armored control cable is a new and worth-while contribution. K. C. Randall stated that it was very evident that the metal-clad type of switchgear was gaining favor and was used in each of the five stations described. The use of a factory-built assembly where each component part is designed as part of a whole is along the line of modern trends. H. Y. Hall said the papers indicated that switchgear and switching are in a state of flux and far from standardized. The trends are apparently away from isolated phase arrangements and concrete construction and toward some form of metal-clad inclosure. It is also advisable to eliminate as far as possible the hazards that may come from oil fires. For example, there should be rugged barriers between the potheads and transformers to prevent fires that may occur due to rupture of the transformer casing from flying particles when the potheads choose to explode.

In his opinion it is difficult to get continuous maintenance on outdoor switchgear, particularly in the northern part of the United States. One advantage of the metal-inclosed switchgear is reduced thickness of the barriers, and this, together with the use of the Deïon breakers, should be economical for saving floor space. In his opinion sectionalized, duplicate ring buses provide a simple, reliable arrangement to meet nearly all standard requirements. In his opinion the wisdom of installing very large generating units is open to question. Voltage and phase-angle control on branch circuits add to the difficulty of getting limited fault values and simple switching installation. In general experience indicates that no system is large enough today to justify units larger than from 80,000 to 100,000 kw.

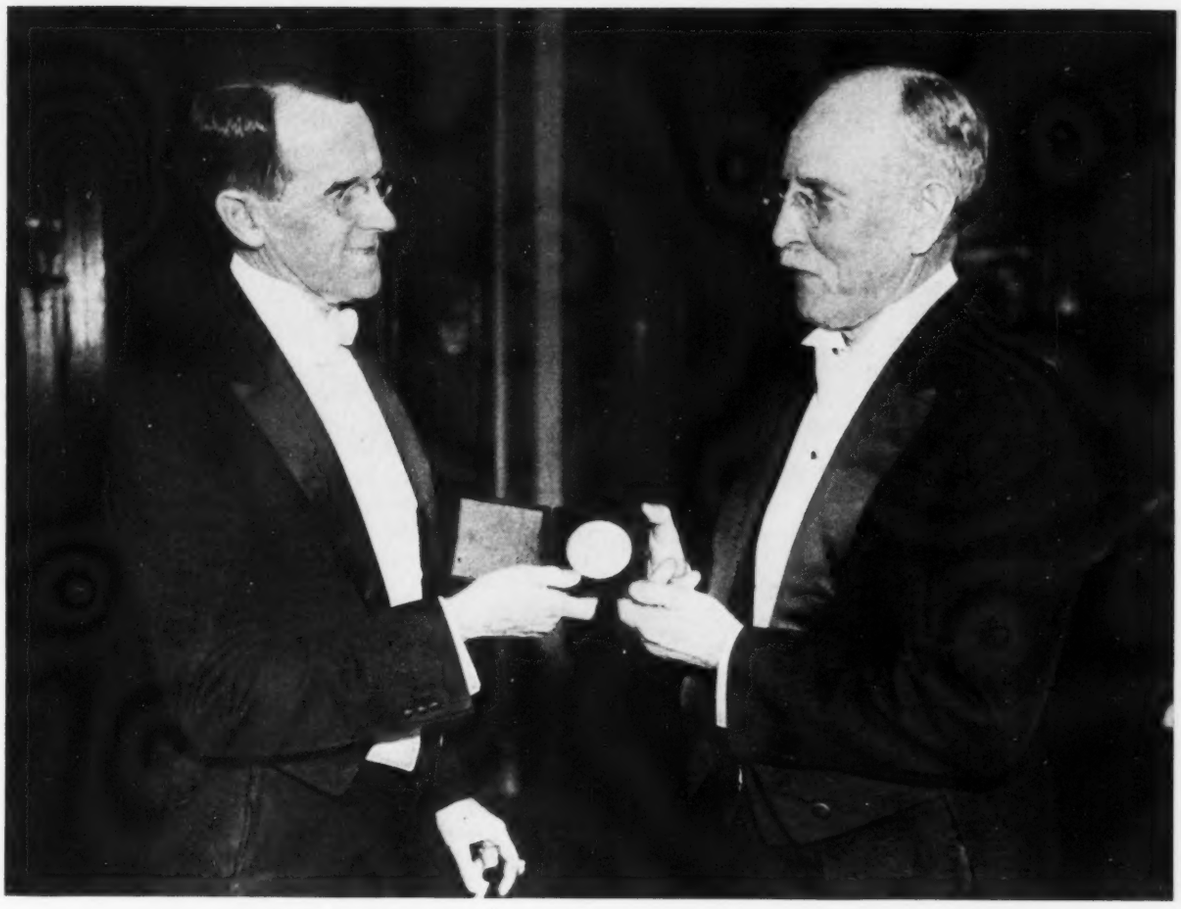
Is one breaker per feeder enough?

PHILIP SPORN said the generalization that the trend was toward high-voltage generation and high-voltage busing was not safe; each case must receive individual analysis. The papers presented were largely descriptive, in his opinion, and some of the stations presented quite a great deal of complexity in switching layout. The Essex station shows very commendable progress in simplifying switchgear. In his opinion only one breaker per feeder is justified as a general principle. The American Gas & Electric System has synchronized at 132 kv. since 1925. It holds the frequency on this large interconnected system to within $\frac{1}{10}$th second. In his opinion the only auxiliary power scheme that can be justified and used on a large interconnected system is that obtained by taking power directly from the main generator or a transformer in the main generator leads. H. R. Summerhayes stated that it was possible to build generators up to 66 kv., but that present studies showed no advantage of this type of generator over the combination of lower voltage generator and transformer as regards efficiency and cost. H. W. Eales said the great advantage of factory-built apparatus is the elimination of labor costs and the prevention of time delays and sometimes labor troubles. The equipment is ready to be installed and put into operation quickly after delivery from the manufacturer. In his opinion a good principle to use in a station design is that an isolating device to be fully effective must itself be isolated. If any engineers violate this principle they are creating a potential hazard. Mr. Eales also stated that too little attention is being given to the oil fire hazard. This should be recognized and design and operating methods utilized to eliminate any hazards of this type. J. Allen Johnson stated that papers of the type presented should stress the principles involved. If this were done engineers would be less apt to be influenced by their own personal hobbies and opinions in their design of new installations. J. K. Ostrander said that an analysis of most systems showed the general use of the double bus sectionalized principle with two main breakers. In his opinion power stations in future would eliminate much of the present duplication of equipment and that this would be possible through the improvement in the equipment itself and through the interconnection of stations. The cost of energy must be reduced in future and this simplicity and this program of interconnecting must be adopted to do this. Equipment today is much better and duplication can be avoided and yet retain an equal degree of service reliability. In his opinion, in the future utility systems will use several small stations instead of single large stations. It was his opinion that the principle of the fault bus is good, but before it is adopted it is very desirable to attempt to devise a system of differential protection that will give equally good results at less cost.

Counterpoise Ground to Help Boulder Dam Line Grounding

ON THE Los Angeles-Boulder Dam line a counterpoise ground consisting of four cables, two under each of the two circuits, brought in to the towers at an angle of 45 deg., give the characteristics of both the crowfoot and the continuous parallel counterpoise. This exemplifies the scheme suggested by C. L. Fortescue's paper at the transmission session. L. V. Bewley felt that the author's assumption of 81 per cent coupling factor between the line conductors and ground wire was high; his own tests had shown 44 per cent for similar configuration. The difference is due to assumption of the depth of the zero plane for the electrostatic field; Bewley said this plane is at the ground surface. Nor, in his opinion, is it necessary to consider several successive reflections up and down the towers because these reflections will have subsided by the time the wave reaches its crest. The wave in the counterpoise is essentially a low velocity wave.

Bradley Cozzens, who reported on the Boulder line counterpoise, said that tests have shown that the radial counterpoise suffers reflections, but that the parallel



J. B. Whitehead A. E. Kennelly

Twenty-second

Edison Medal Awarded Dr. A. E. Kennelly

"As an honorable incentive to scientists, engineers and artisans to maintain by their works the high standard of accomplishment" set by Thomas A. Edison, the American Institute of Electrical Engineers makes annual award of the Edison Medal, highest honor in the electrical engineering profession.

This year presentation was made to Dr. A. E. Kennelly, assistant to Edison in his Orange, N. J., laboratory from 1887 to 1894, consultant for the General Electric Company, professor of electrical engineering at Harvard University from 1902 to 1930, concurrently professor of electrical engineering at Massachusetts Institute of Technology from 1913 to 1924, twice president of the A.I.E.E., a former president of the Illuminating Engineering Society, of the Institute of Radio Engineers and numerous other organizations.

Dr. J. B. Whitehead, president of the A.I.E.E., presented the award to Dr. Kennelly at the institute winter convention last week.

counterpoise has no tendency to build up the potential at the tower base. He had found it necessary to use a value of K (in connection with the dielectric constant of the soil) up to 8 or 10 in order to have computed values check the test values for counterpoise effectiveness. As for the earth condition, he believed it quite possible for moisture in seams of high rocky projections to create higher ground conductivity than exists for the dry areas of the desert. J. E. Clem cited calculations which showed losses introduced by the power-frequency coupling of line and an underlying counterpoise to be negligible. Induced current in the overhead ground wire might be 7 per cent and $2\frac{1}{4}$ per cent in the counterpoise, but the corresponding losses would total to considerably less than 1 per cent. Distribution of the loss is unbalanced and is affected by reversal of the phase sequence.

Heretofore the diameter (and with it the weight and the cost) of the overhead ground wire has been determined to suit the structural requirements of strength, said S. S. Hertz. He saw nothing new in the situation which called for larger conductors merely to add to the protective value of the ground wire or to loss control. The cost of a pair of $\frac{5}{8}$-in. ground wires might be $2\frac{1}{2}$ times as great as for $\frac{3}{8}$-in., but with protective gain of less than 5 per cent. Better to apply this outlay to greater separation or higher insulation than to spend it for increased conductivity of the ground wires. Less than 2 per cent of the Copperweld ground wire in service is more than $\frac{1}{2}$ in. in size.

Corona determined by weather and altitude

ADVERSE comment on the paper by Messrs. Carroll, Cozzens and Blakesbee which reported corona test data on the conductors submitted for the Boulder Dam line resulted as they did not present figures for other than ideal operating conditions of temperature, low altitude and low humidity. These variations, said Prof. C. F. Harding, will make the losses vary far more than the differences in conductor surfaces as studied. The maximum value of $1\frac{1}{2}$ kw. per mile found in the paper might increase to 29 kw. per mile at the highest altitude encountered. L. F. Hickernell said that aging and oxidation would obliterate most of the differences found between the stranded and tubular assemblies. It was further pointed out by J. H. Foote that eleven-unit insulator strings had more loss in kilowatts per mile than would be occasioned by corona on any of the conductors in fair weather. To him it was evident that corona loss had not ruled in the selection of the conductor design for the Boulder Dam line. T. F. Peterson said he thought that "submerging" of the joint in conductor F (page 177) was merely an effort to have the smooth conductor simulate the superior properties of the stranded conductor in wet weather.

Raising the stability limits

As has been said many times, if the protection engineer would provide a lightning-proof line the stability engineers would raise the limit of stable operation of the system. The higher static limit would replace the lower transient limit, said G. D. Floyd, and system costs would be reduced per unit of safe capacity. Intermediate condensers could also then be used advantageously and thus set the static stability limit itself at higher levels. When fault does occur, however, and fast switching is the means adopted for preserving stability the energy that may be transferred to the fault may be fixed more by the steady state limit than by the characteristics of the first swing. An ideal arrangement suggested by S. B. Crary, one of the authors on the program, would be to inject braking resistance only during the first swing of the system. When a system is extended and complicated the machines may swing in several groups, according to Edith Clarke, rather than in merely two groups embracing respectively the governor-regulated and the frequency-regulated groups. The Petersen earth coil appears not to be applicable in the case where fault occurs between machines within the load area; systems under such circumstances would not be adequately represented by two equivalent machines embracing distant generators in one group and the load area machines in another.

The real objective in stability aspirations was said by R. D. Evans to be the economic comparison of system layouts so chosen as to evaluate and derive the benefits of faster breaker action in clearing of faults in contrast with the other methods of promoting stability.

Lowest Distribution Costs Depend on System Used

THREE cities by name (others by inference) were cited in the distribution session as having decided upon a radial scheme in some circumstances, networks in other instances and a composite scheme in still others. D. K. Blake, long known as a proponent of the primary network, was positive there was as much reason for differences in circumstances *within* a city as *between* cities as a whole. Therefore, as several others agreed, there is a logical place for radial, for primary network, for secondary network, and probably, according to W. R. Bullard, for the higher voltage direct deliveries to the distribution transformers.

Bigger than the reaffirmation of this simple logic was the fact that the institute has done exactly what its chief critic, Morris L. Cooke, has said it persistently refused to do, namely, to inject a dollar sign (occasionally at least) into the engineering economic analyses of distribution. Detailed costs were given in the papers and the subterfuge of expressing everything in relative index numbers was discarded. The significant thing that is likely to be overlooked, however, is the fact that these figures pertain to the core of major distribution costs and not to the exposed poles and overhead wires that some people still think typifies all there is to distribution economics.

Local geography, street plans, ordinances and customs are the "circumstances that alter cases," and it was not surprising that hardly any two analyses agreed in the conclusions. Somerville, Mass., presents a stocking-shaped area and the Buffalo authors emphasized the interference of parks, rail routes, etc., as spoiling the symmetry for which the network is ideal.

The advent of the automatic substation has been the biggest factor in controlling distribution costs. Standardization on small factory-built units at short spacing would, in the opinion of J. S. Parsons, be a further great contribution to distribution economics whether adapted flexibly to radial or network. At least this

procedure leaves the distribution engineer free to focus his energy on the design of the system rather than on stations.

Brooklyn, to C. M. Gilt, resembles the Buffalo problem of R. T. Henry and J. A. Johnson. For low load densities the radial seems to prove best and the low-voltage network best for the high load densities. A study of outages on the Brooklyn system showed an average per year per customer of 21 minutes of outage on the radial and of 3.3 minutes on the underground network. An outage of 160 minutes on the underground network would occur once in something like 490 years at present rates by projecting the analysis of the recorded data.

Small increment units best

C. T. SINCLAIR, symposium sponsor, said there were still differences in the basis of analyses so that the several estimates are not strictly comparable in all particulars. The problem is intricate and there is no reason to expect immediate unanimity of thought. On one thing there is agreement and that is that the urge to analyze distribution has confirmed the virtue of the small increment unit. Beyond that each engineer has aimed at a decision which gives best economy for his local conditions. D. K. Blake hoped the engineers would continue to approach the problem without bias. What exists already in the distribution system has more influence than anything else upon what shall succeed it. He submitted an extended written discussion which compared the network system as a grid and the same (Buffalo) 2,500-kva. units connected as a radial system. For the network to have a substantial economy over the equivalent radial system there are two requirements to be met: First, the circumstances must be such that the network will actually save 4-kv. cable and underground construction; second, for large areas permitting a common network over the entire area, or what is the same thing, a smaller area of higher density permitting a large number of units interconnected into a common network, the network will not only save money on cable and conduit but will also save money on substations and even transmission cable if the distance between the area and the generating station is substantial. Any attempt to apply a network to circumstances other than these is very likely to show a greater cost for the network.

C. A. Corney said that Chicago's choice of a network would result in 4½ per cent more cost than the radial if analyzed on the same basis as Boston's study. This is too small to influence the decision against the factors of switching, voltage regulation, handling of faults and other service quality factors. H. J. Osterreich's 11-square-mile study in Pittsburgh showed substation costs comparable to the costs of network units. He emphasized that retired and immediately unused equipment should be charged against the scheme which occasions the retirement.

These distribution analyses are expensive and H. W. Eales urged that distribution engineers be sure to get enough money into the budget to conduct them adequately if reliable results are desired. As for separating the switch from the transformer, he was for it, because in one case it was actually cheaper to build the vault that way, the partition supporting the roof and making the over-all job cheaper. C. M. Gilt said, however, that Brooklyn has had eleven failures of network transformers, potheads, etc., and four on the attached network switches, but none in either group had occasioned a failure in the other group. L. Z. Kidder suggested that considerable economy in design could be effected merely by subjecting the equipment at infrequent intervals of abnormal peaks to unconventionally high overload temperatures.

In a substation the load division is inherently uniform, but network impedances tend to disturb the equal division. T. H. Haines said that experience on his property in Boston was good, citing three triangularly spaced stations about 1½ miles apart on a network. Nor did they have anything but correct functioning of relays in clearing both sides of the units under fault. One fault threw all the 2,000-kw. load on one of the units and the respective voltages during the half-hour duration of this condition were about 112, 118 and 116. Malden's primary network units, according to G. O. Eaton, were installed in anticipation of load growth that did not materialize. They have been operated successfully as radial units. The initial substation investment to meet the anticipated conditions would have been twice as great as the network units fortunately chosen.

Overlooked more or less by all the papers was the direct distribution at 6, 11 and 13 kv. Many companies reported by W. R. Bullard are using this successfully. The imagined difficulties have not materialized. In this he was confirmed by William Shuler, who said his companies were seriously looking into the feasibility of adopting it.

Industrial Furnace Progress Awaits Some Standardization

TRANSFORMER manufacturers remark whenever a furnace manufacturer sends a second requisition for a transformer identical in rating or regulatory features with the one that went before. Furnace manufacturers would like to see two customers operating identical furnaces at anywhere near the same multiple of rated loading or input. Furnace customers would, of course, like to see power rates lower and in general less complex. The utilities said at the same electrometallurgy symposium that they long for the furnace loads that have good load factor and few bumps to disturb the voltage delivered to the other customers. But on one thing all parties were agreed, and that is that electrically melted and refined cast iron is no more expensive to produce than cupola iron and is so much more readily machinable than forgings that it is fast replacing the cast steels and forgings for high-pressure fittings, automotive parts, even in one instance reaching to the crankshaft itself.

Electric iron has higher fatigue resistance and in many cases a modulus of electricity which surpasses that of alloy steel forgings. Less vibration and distortion of the shaft are factors in attaining higher car speeds and higher gas economies. Brake drums and clutch plates have gone from steel to iron. Tappets of electric iron have two to five times the life of cupola iron tappets, said E. L. Crosby. Stoker grate bars have longer life. Small motor parts are being made extensively from decarburized steel scrap.

Distribution lines to furnace loads can hardly be designed intelligently, said T. F. Hillebrand unless the electric rating of a furnace and its transformer mean

something definite. It is also necessary to know the degree of overloading, forcing and of cold start input. As well as being able to serve the furnace customer, it is necessary to protect other customers against service detractions from bumps in the furnace load. C. L. Dudley welcomed the use of reactors to hold the inrush current to a cold charge-down to reasonable figures. Voltage regulators then have a chance to function before the reactors are short circuited. He felt it was unfair to tax other customers either in poor service or in higher rates to make up for loss incurred by inadequate recovery from the furnace user.

Action by furnace makers asked

CONCERNING standardization of furnace and transformer ratings, Frank Brook said that it was more a matter of standardizing the customer's expectations and getting power rates standardized in form than anything else. But more seriously, he said the furnace builders are as much to blame as any one for the lack of significance of present furnace ratings. He avowed that Swindell-Dressler would co-operate in a standardization program so the customer and the utility alike will know more definitely what they are to expect as to inputs and outputs. The electrical rating of the furnace at present means little more in actuality than a tonnage rating. At least some of the intervening steps in kva. rating could safely be consolidated. As for the holding capacity, the shell diameter and some vertical depth dimension would suffice, but each manufacturer would have to make some sacrifices in design for the sake of standardization in this particular. Even with standardized ratings it would still require an electric furnace engineer in operation so that the desired results in quality and tonnage could be secured consistently.

The real difficulty in rating standardization, in C. C. Levy's opinion, is the fact that it takes four items—charge, output, shell size and transformer capacity—to fix the scale of size of a furnace. No one of these suffices and no alternative has been devised. American Bridge Company practice, according to Samuel Arnold, is to establish a nominal rating and provide for large overcharge because the customer has been educated to expect just that.

Mr. Arnold said that heat could be saved by insulation of the shell and trials were worth making. W. E. Moore said some attempts to conserve energy by insulation at the same time that inputs were forced upward led to grief from lining failure. What is saved on the demand charge by applying insulation to the shell may be lost in refractory maintenance. In his experience the walls of the three-phase furnace show less tendency to cave in than does the single-phase, but, on the other hand, the roof is relatively weaker and it is more necessary to favor it in the design. Samuel Arnold, 3d, believed the old idea that radiation was the proper way to keep the refractories cool is capable of modification, but resort to wall insulation must be made cautiously.

A bit of argument arose about the effect of the magnetic forces in the direct arc furnace as compared with the rotation of the rocking furnace in keeping the melt uniform in composition throughout. One discussor said this force in the direct arc furnace was great enough to afford the stirring effect, but generally not great enough to scour the walls by too high velocity of molten flow. Mr. Crosby made the point that the rocking of the Detroit furnace made it possible to keep the metal stirred when the current was off. He cited remarkable figures to show the close conformity of assays with desired varying compositions of a sequence of "pours" that followed intervening make-up charging.

Ability of the electric furnace to use up cheap scrap in producing superior iron resulted in savings that usually are great enough to pay for the kilowatt-hours, said M. V. Healey. In cost there is little difference between cupola and electric iron. The difference is in the value of the product. Another discussor made the point that if the utilities really grasped the importance of the load that awaited them as this point became more generally appreciated among foundrymen they would make rate inducements to encourage the business. He went so far as to say that no amount of alloy material added to cupola iron could duplicate the fine grain, high machinability, high strength and high endurance of electric iron.

It was the spirit of the occasion that utilities, furnace manufacturers, furnace transformer manufacturers and maybe some of the users could very profitably get together for the sake of understanding one another's problems, thus erasing the obstacles to sale of more kilowatt-hours, more furnaces and more furnace iron. The manufacturers gave assurance that they were ready to do their part, but still fear that the furnace user needs to be regulated to a standard more than any one or anything else, except rates, if the furnace load is to move.

Mercury Rectifier Refinements Offer 85 per Cent Space Saving

A RADICAL change in rectifier practice was predicted by F. A. Maxfield, one of the authors, in discussing the paper on the ignitron rectifier. By water cooling the mercury cathode and by mounting each pair of electrodes in a single tank a safe prediction was made that successful rectifier units of only 15 per cent of conventional size are possible, that will be more efficient, cheaper and with less arc-back trouble on the basis of preliminary tests. L. R. Ludwig pointed out that they have been successful under abnormal temperature and pressure conditions. K. B. McEachron, General Electric Company, praised J. F. Calvert's job on protecting machines from line surges and brought out the fact that arresters located at midpoint of star and centers of each leg protect the turns from reflection.

The more exact method for getting the equivalent reactance of synchronous machines (Crary, Shildneck and March) was recognized as an advance over empirical methods of the past, but of little practical value, according to L. E. Kilgore of the Westinghouse company, who also criticised the authors' omission of the effect of pole tip densities. A simplification of reactance discussions could be made if the A.I.E.E. would standardize the definition of leakage reactance.

The control of voltage and power factor by load ratio control and fixed capacitors has come as a result of the evolution in capacitor construction from a laboratory specimen into a commercial product. The actual economic advantage of this type of control relative to synchronous condenser equipment can only be established

by a cost analysis of each particular case, according to L. F. Blume, one of the authors, so he could not give any comparison. The methods of computing harmonic voltages produced by power rectifiers in the joint effort paper for co-ordinating telephone system and a.c. power systems were recognized as a distinct advance, even though the results do not check absolutely with tests. P. W. Blye pointed out that one of their actual tests for low voltage and high loadings gave an error in calculation of only 10 per cent, which is not considerable for non-linear circuit analysis, according to Dr. Weber of Brooklyn Polytechnic Institute.

What Tests for Bushings? Demand Meters Warmly Debated

CONDENSER bushing measurements and demand meters evoked wide discussion at the measurements session. As for the former, the comments focussed largely on the comparative merits of the Doble tester and the portable Schering bridge developed by Westinghouse for field tests. As reported in great detail by Messrs. Gross and Turner in ELECTRICAL WORLD of January 13 and 20, 1934, it is nothing short of folly merely to replace bushings and instrument transformers which have failed without searching for the contributory causes. The Doble tester provides a means of disclosing these conditions before they mature into breakdown. As an example, a successive dissection of one bushing showed that felt washers had picked up moisture and under tests showed the 100 per cent power factor which accounted for the 15 per cent power factor of the assembly. It had also segregated bushings which had successfully passed the 60-cycle test but failed on the impulse test. These facts, in the opinion of Philip Sporn, belied the assertion in the Westinghouse paper that nothing was available for the companies to use themselves in this work in the field.

Manufacturers now are disposed to accept the power-factor test of bushings as an index of their condition. E. S. Lee confirmed this by saying that power-factor readings are of more significance than insulation resistance measurements, The question now to settle is the level of limiting values to take as the dividing line between acceptability and non-acceptability. H. H. Spencer had used the Doble equipment with success, but asserted that it takes competent engineers to apply it and competent engineers to interpret the results. E. D. Eby said different materials were capable of functioning satisfactorily at different values of individual power factor and therefore care must be exercised in interpreting the meaning of tests on composite apparatus. H. S. Phelps reported that tests on oil-filled bushings had given utterly inconsistent results. He is still seeking the index which can safely be used for capacitive devices to continue in service without risk of early failure.

Prof. P. M. Lincoln considered the new involute-cam exponential demand meter of the Westinghouse company as a testimonial to the propriety of his thermal demand meter, for which he had assigned the rights to the Westinghouse company twenty years ago. Even though it came twenty years late, he still was disposed to call the equivalent mechanical device a recognition of the superior properties of the thermal meter in getting accurate integration of short-duration, erratic peaks. The block-interval meter of course splits the peaks and really has rigorous significance only for loads that overlap two or more demand intervals. For those who are in doubt about this he suggested putting two demand meters on the same load, but staggered so that one half-overlapped the demand period of the other and then applying an irregular load for a portion of the period. Canada has something like 150,000 of the thermal demand meters in service, but there are so far very few in this country, and Mr. Lincoln made no secrecy of his reason why.

To offset this faith in the greater theoretical accuracy of the thermal meter H. R. Woodrow reminded the audience that the objective of the demand meter is to assess the costs of service upon the customer. Rigorous technical accuracy of the thermal meter might not mean that it came any nearer to reflecting the demand cost in its reading than does the block-interval type of meter which rules in this country. R. E. Hellmund, too, said it was largely a matter of commercial expediency that the thermal demand meter here had lagged behind the block-interval type; he was quite ready to acknowledge the greater theoretical accuracy of the thermal meter. As for the "Rube Goldberg" characterization of Professor Lincoln upon B. H. Smith's new device the latter said that was answered by the practical functioning of some $2,000,000 worth of Ball-type reactive-kva. meters of the Westinghouse company now in service. They also use a ball as an integrating medium, but under a quite different principle. He and Professor Lincoln beamed upon one another and grasped hands when the session ended.

Future for Auditory Perspective?

J. B. JEWETT, under whose direction the work was done, thought the esthetic value of auditory perspective, or stereophonic reproduction, would outweigh its commercial value. Dr. Harvey Fletcher pointed out that the system is only applicable to auditoriums where the illusion can be produced of the presence of performers that are actually on the stage of a different auditorium. Cognate developments offer the prospect of music reproduction above and below a level that is mechanically possible at present, and of a wider dissemination of good music than is possible at present. J. B. Taylor, General Electric Company, held that the binaural earphone system would be a more practical system. He also thought for such a system as used that better results would be obtained with one microphone and speaker channel for each source of sound to be transmitted. General Squire congratulated "big business" for making this accomplishment possible during the depression, and predicted big things for music as a result.

•

At the opening session of the convention a bust of Frank J. Sprague was presented to the institute by Frank Hedley, as chairman of the Sprague Anniversary Committee. Mr. Hedley outlined the career of Mr. Sprague and said he truly deserved the title of "Father of Electric Transportation."

What Would Inflation Do to 1934 Kilowatt-Hours?

By GEORGE J. READ*
Engineer System Planning Division, Brooklyn Edison Company

COGNIZANCE of the movements of national economic activity is more important than consideration of local influences in forecasting 1934 energy sales. Depending upon whether inflation is injected and whether in mild or drastic form, energy sales for a major utility may be from 5 to 15 per cent higher in 1934 than in 1933. If the middle road of mild inflation is followed, it is conservatively estimated that the increase will amount to 8 per cent.

In arriving at these values, two methods are used which are akin to the two methods described in a previous article dealing with long-term forecasting.† One method attacks the problem from the viewpoint of national business activity with nation-wide economic effects, namely, the possibility of inflation given greater weight than local factors. The other method arrives at the 1934 annual value by means of an analysis of number of meters and use per meter for the various classes of consumers and derives the monthly values from seasonal variation with emphasis on its changing characteristics.

What is the effect of inflation on business? It is a delay of final recovery brought about by an artificial and short-lived spurt in business. A glance at the fluctuations of business activity immediately preceding and during major depressions, Fig. 1 to 4, discloses a uniformity of movement which is unmistakable. This is all the more remarkable considering the changes in transportation, communication, methods of agriculture, manufacturing and banking which have taken place over the past century. In every case the cycle included: First, a period of rapid expansion, overoptimism and extensive speculation; second, a maladjustment of the monetary system, followed by loss of confidence which resulted in panic; third, a period of profound pessimism, failures, debt repudiation or adjustment and, fourth, a period of revival. In three cases out of four, namely, in 1815, 1837 and 1893, the period of depression was punctuated by inflation, which in each case resulted in rapid temporary recovery, followed by the inevitable

*In collaboration with W. S. Brush, S. M. Hall, H. G. Knaf.
†See ELECTRICAL WORLD, December 16, 1933, page 780.

Bank-note circulation rose from $45,000,000 to $100,000,000 up to 1817. Rapid migration to the West began in 1816, which augmented the effect of inflationary measures by decreasing unemployment.

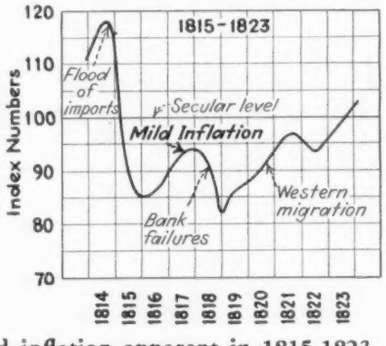


Fig. 1—Effect of mild inflation apparent in 1815-1823 post-war depression

Many bank failures in 1837, due primarily to overspeculation in Western land. Drastic inflation occurred in 1838-39, when Biddle, through the Bank of U. S., cornered the international cotton market, paying the U.S.A. farmers in paper money and selling the cotton in Europe for hard cash.

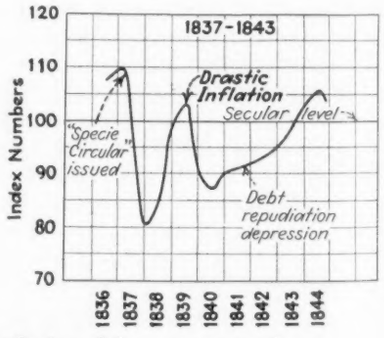
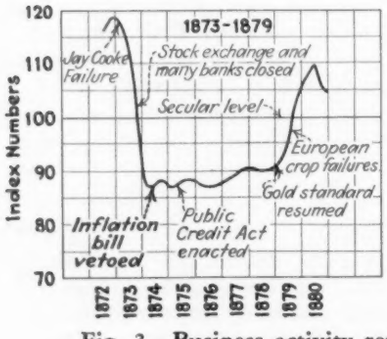
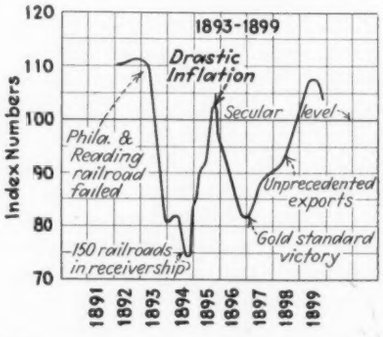


Fig. 2—Drastic inflation delays recovery from depression of 1837-1843



Bill providing for a permanent increase in greenbacks up to $400,000,000 vetoed by President Grant in 1874. Public credit act contracted greenback circulation to $300,000,000 and called for resumption of specie payments after January 1, 1879.

Fig. 3—Business activity returns to normal without inflation in 1873-1879



Scarcity of money forced greenbacks and silver again into circulation in 1895, which forced the U. S. Treasury to replenish its gold stocks by bond sales aggregating $262,000,000. Bryan's free-silver coinage campaign precipitated a decline in public confidence in 1896, culminating in the election of McKinley and resulting in a victory for the gold standard.

Fig. 4—Drastic inflation interrupts 1893-1898 depression

relapse and the slower, more permanent recovery. The length of these major depressions appears to be from five to eight years and the effect of inflation appears to be a postponement of final recovery by one or two years. If an unhurried process of liquidation takes place, as in 1873, it results in the weeding out of unsound business, the adjustment of debts to a deflated level and a permanent correction of past excesses.

Inflation so far not monetary

Which of these patterns will the present depression follow? From Fig. 5, showing the present depression, it is seen that the latter process of slow liquidation or complete deflation has already been ruled out. The inflationary symptoms are clearly visible. Thus the present depression has to be classed with those of 1815, 1837, 1893. However, there is one fundamental difference. In these previous depressions inflation was represented by one sudden rise of the business index, caused by one specific measure, such as the bank note inflation in 1817, cotton boom in 1839, bank note inflation in 1895, to be followed only by a deep relapse which postponed final recovery.

This depression, however, is characterized by a multiplicity of inflationary moves, the major ones being: (1) Credit inflation (R.F.C.); (2) public works inflation (P.W.A. and C.W.A.); (3) NRA (minimum wage, shorter hours), A.A.A., C.C.C., etc.; and (4) probable currency inflation. The spurtlike rise of the index in the middle of 1933 evidently was caused more by the fear of inflation rather than actual currency inflation and by speculative impulses due to the imminence of the NRA codes. It was more a psychological than actual inflation and therefore receded after these psychological factors had played out. Nevertheless it exercised sufficient effect to turn the cyclical trend of the index upward. The bottom of this recession falling in November marks a crucial stage of the recovery. Will revival be left to the milder and slower inflationary measures, such as credit expansion, public works, NRA and the fundamental factors of recovery, such as depletion of stocks and return of confidence? Or will additional and more direct inflationary measures be resorted to, culminating in outright currency inflation?

War inflation primary cause of present depression

In Fig. 5 three probabilities of revival from this depression are depicted. The derivation of these revival trends from 1932 to 1937 is based upon a theory of the business cycle which states that business cycles are made by business booms. If booms could be prevented there would be no business cycle as we now know it and, therefore, no depressions. In other words, it is the economic excesses of previous prosperity that cause depression and not depression that causes a succeeding boom.

Therefore, properly to understand the causes of the present debacle so as to forecast its depth and duration, as already done in 1930, it is necessary to take a broad view of the past and not merely say this recession is the result of the 1927-29 boom alone. Instead, it is the result of the entire series of booms initiated by the 1914 war boom with the slight interruption of the 1921 depression, as illustrated in Fig. 6. In this light it is the accumulation of all the excesses resulting from artificial prevention of the working of natural economic law

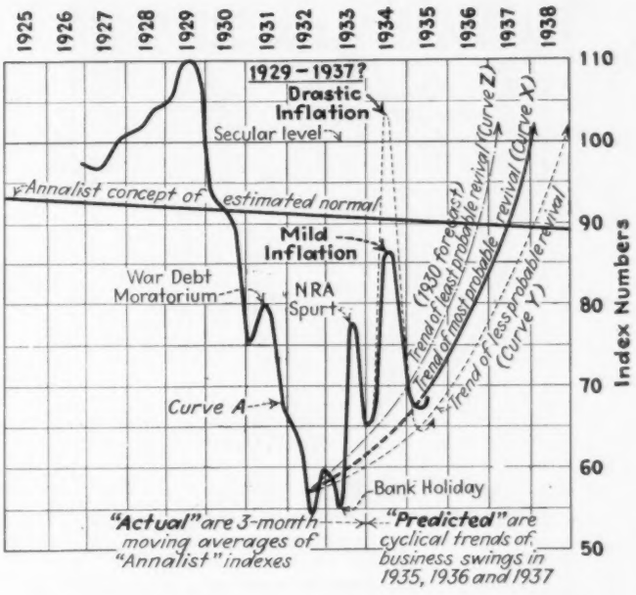


Fig. 5—Probabilities of revival from present depression

Forecast of the amount of subnormal area in 1930-1937 as indicated in this figure was made in 1930. This forecast was based in part on the theory of the business cycle that the supranormal area from 1915 to 1930 must be ultimately corrected in this depression, assuming no inflation forces would interfere. For further discussion of this forecast see previous article in ELECTRICAL WORLD, December 16, 1933.

The present depression area has already been interrupted by the NRA spurt in 1933, when the business index rose approximately 22 per cent from March to July. A new and larger inflationary spurt due to P.W.A., A.A.A., C.C.C., etc., is expected in 1934.

Curve X represents the cyclical setback due to mild inflation in 1934, whereas curve Y represents a greater setback should drastic inflation be resorted to.

The 1933 revision of the 1930 forecast of the shape of the present depression area is based on the past effects of inflation on the business cycle as illustrated in Figs. 1 to 4 inclusive. The effect of inflation will be to modify the shape of this depression and not the amount of it.

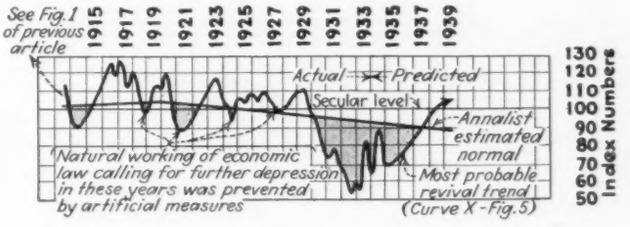


Fig. 6—Present debacle primarily caused by world-war inflation

1916-18 boom was due to World-War inflation. Signing of the armistice was cause of 1919 recession.

1921 depression was arrested by the open-market operations, etc., of the Federal Reserve system, resulting in a credit inflationary boom in 1922-23.

1924 depression was arrested by the easy-money policy of the Federal Reserve Bank of New York, which culminated in a credit and price inflation during 1925-26.

1927 depression was arrested by the cheap-money policy of the Federal Reserve system, which was augmented by the passage of the McFadden act permitting easy credit to stimulate security market operations.

1930 depression evidently could not be arrested by artificial measures, since economic law ultimately requires the correction of excesses resulting from war, easy credit and other factors causing booms.

which calls for "periodic" corrections. Hence, the severity of this depression is not surprising, because most of the excesses committed during the past twenty years were not corrected before 1930. It is in view of this fact and also the factors of average cycle length, average relative slope of revival phase to recession phase, etc.,

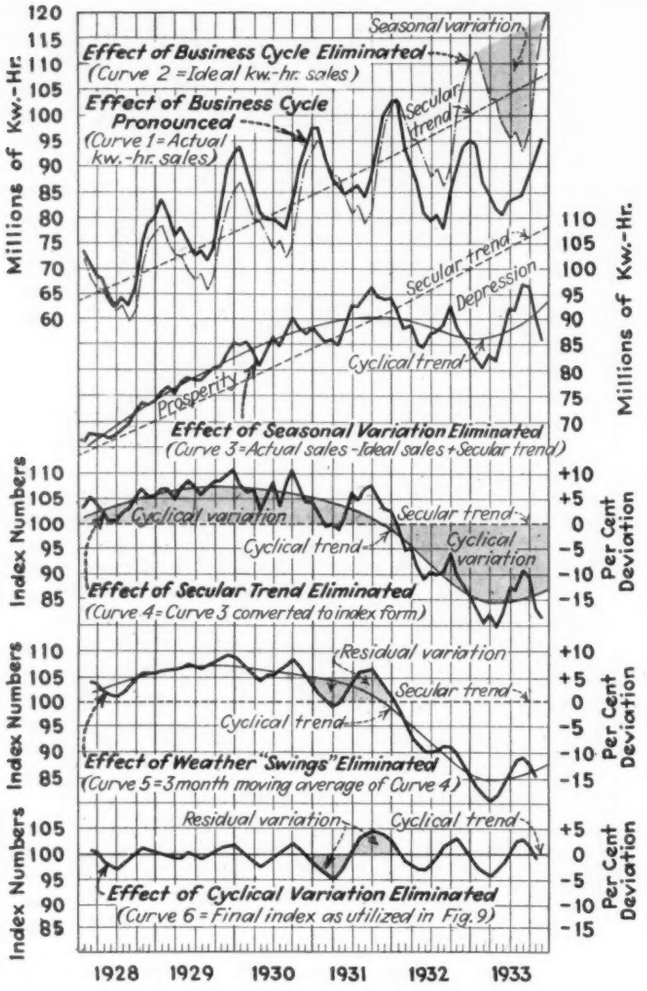


Fig. 7—Evolution of local kilowatt-hours into index form

Seasonal variation, cyclical variation and residual variation; also secular and cyclical trend are defined graphically.
The secular trend is based upon the fitting of a parabola to annual data since 1910. It represents a relative rate of increase in sales of approximately 9 per cent per annum.
The "normal" seasonal variation is derived from the average seasonal movement of actual sales for the period 1919-1932. This concept of seasonal variation is employed by the first method.
The final index of kilowatt-hours (curve 6) is employed as a short-term forecaster of future monthly sales, described in conjunction with Figs. 8 and 9.

mentioned in the previous article, that the business cycle is not projected to the secular level prior to 1937. This assumes that all uncorrected excesses will be corrected in the present depression without resorting to inflationary measures.

Possibilities of inflation for 1934

However, as subsequently discussed, inflationary measures, if carried out, are quite likely to interrupt the present depression area in 1934, thereby changing the shape of, but not the amount of, the area. Curve Z, Fig. 5, illustrates a type of recovery where deflation and liquidation are given full rein, such as would prevail under a *laissez-faire* policy, with things left to adjust themselves as in 1873-79 without inflationary policies. Under these conditions a return to the secular level of business activity could be looked forward to by 1937. This type of recovery, however, has been definitely ruled out by the course already adopted by the Administration and has only academic value.

Curves X and Y (in Fig. 5) depict two possible ways of recovery now left open, X with a mild inflation (credit, public works and NRA), and Y with outright currency inflation. The milder form would insure a return to the secular level by 1938 and to the *Annalist* estimated normal by 1937, whereas monetary inflation, with its inevitably deeper recession, will postpone the final recovery almost one year. There are many indications that the latter path will be used only as a last resort. Considering the growing public opinion against currency inflation even among those circles that are supposed to profit mostly by it, the median, or curve X, which is an average of Z and Y, is chosen as the most probable prediction of business revival. It is the projection of the business index which plays the most important part in the prediction of 1934 kilowatt-hour sales, as will be explained later in this discussion.

Two approaches are available

In a long-term prediction, where ten years are involved and the emphasis is placed on long-term trend and cyclical variation, only annual values are sought. Further, the year immediately ahead is not given any more emphasis than the ones to follow. The short-term prediction, however, focuses all attention on the coming year. Therefore, the annual value of kilowatt-hour sales, already established in the long-term forecast, is reconsidered. For this purpose the index of national business, which is a prerequisite of the first method of approach, is introduced in its monthly form to permit better use of its barometric quality with respect to local kilowatt-hour sales, since the kilowatt-hour cycle lags business by less than one year.

The manner in which the national index of business is extended into the future as a preparatory step to the forecast of kilowatt-hour sales is shown in the foregoing discussion on inflation. However, the annual kilowatt-hour value produced by this method constitutes only a preliminary solution. The final value is obtained from a compromise between this value and one derived from a second method which builds up the total kilowatt-hour sales from an analysis of the various classes of consumers with numbers of meters and use per meter playing a part. The annual values for the classes, as previously set up in method two, are now adjusted so as to add up to the final 1934 kilowatt-hour sales total. The establishment of the annual value for the total kilowatt-hour sales, as well as for the classes, marks the first step of the short-term forecast. From this common basis the two methods proceed in different ways to accomplish the second task, namely, the breakdown of the annual values into monthly ones.

Statistical terms defined

It may be well to elaborate at this point on some of the terms that occur constantly in any discussion of forecasting of monthly values. The "raw" data, such as monthly kilowatt-hour sales, that are given to the forecaster cannot be used without considerable refinement, because they are composite measures consisting of a number of unrelated items. They must be broken down into their elements and are found to consist of the following components: Long-term trend, seasonal variation, cyclical variation and residual variation. About the last three, short-term forecasting is mainly concerned. They are defined as follows:

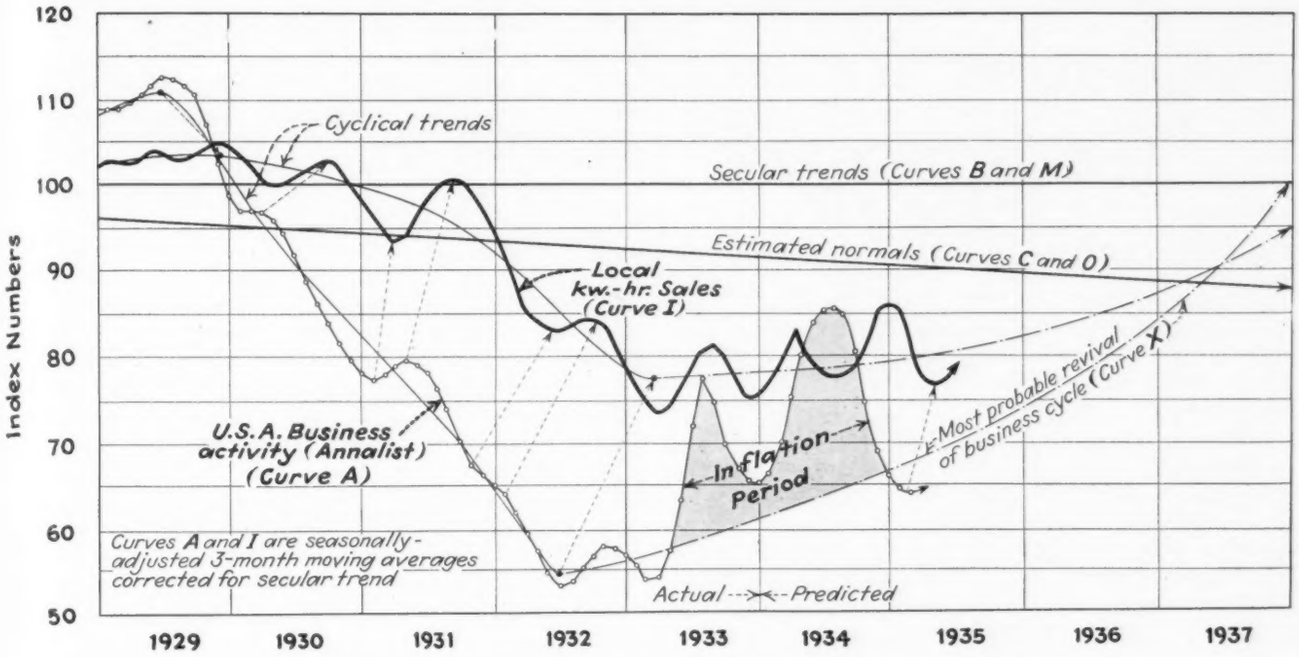


Fig. 8—Local kilowatt-hours foretold by national business conditions

This chart is a continuation of Fig. 2 of previous article (see ELECTRICAL WORLD for December 16, 1933) where curves A, B, C, I, M and O are explained in detail. In addition, the lag phenomenon of local kilowatt-hours behind business activity is explained there, which is the key to this method of short-term forecasting of kilowatt-hours.

The 1934 prediction of business activity, based on mild inflation, is transposed from Fig. 5 to this figure (as shown by curve A). This transposition is made to facilitate the derivation of the "residual" index of business shown in Fig. 9.

The 1934 prediction of the kilowatt-hour index based on the lag phenomenon is transposed from Fig. 9 to this figure (as shown by curve I). This transposition is made to facilitate the conversion of curve I into 1934 monthly, absolute values of kilowatt-hour sales.

Based on the projection of curve I, the residual indexes for each component class of total kilowatt-hour sales are projected ahead, parallel to and "leading" or "lagging" curve I (as the case may be). From these projections 1934 monthly sales are obtained for each class by this so-called deductive method.

Seasonal variation is the tendency of statistical data to deviate uniformly from the yearly average, successively for at least ten years.

Cyclical variation is the tendency of statistical data to deviate from the long-term trend in a sinusoidal manner; for example, the business cycle.

Residual variation is the remainder of the original data after all other variations are removed and is primarily caused by weather influences, accidental breaks in the data due to strikes, NRA codes and inflationary measures.

A graphical description of these terms and the various processes of refining the "raw data" is given in Fig. 7.

National business a key to local kilowatt-hours

It is now clear that the U.S.A. business index and the local kilowatt-hour sales index, used by the first method, represent the residual variations superimposed on the cyclical variation with long-term trend and seasonal variation removed. When presented in this form (Fig. 8 in conjunction with Fig. 2 of previous article) the two indexes offer an insight into their correlation, which

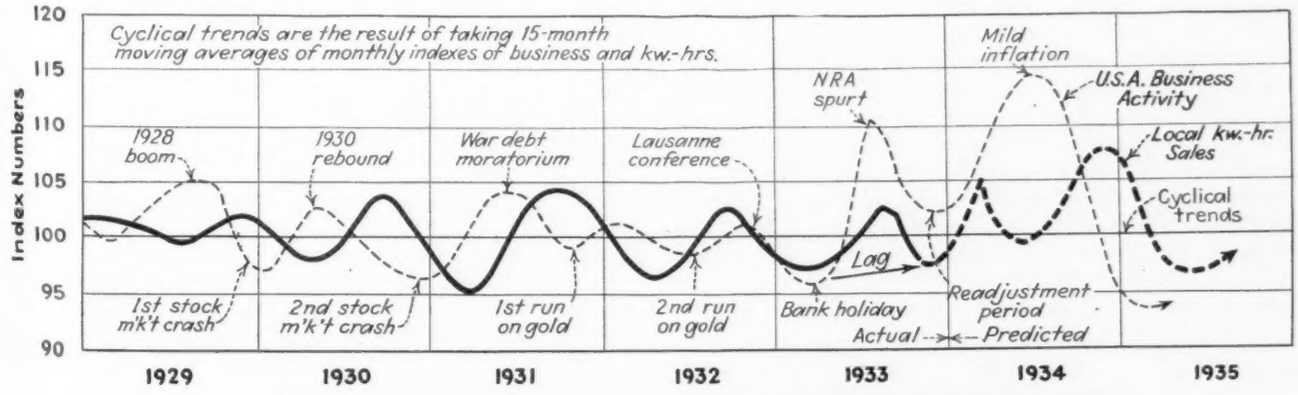


Fig. 9—An "oscillogram" of U.S.A. business and local kilowatt-hours

This is the key to the first or "deductive" method of short-term forecasting in which business and kilowatt-hours are correlated in their simplest forms.

The U.S.A. business "residual" is derived from Fig. 8 and used here as a barometer by means of which the local kilowatt-hour "residual" is projected ahead, parallel to and lagging the residual variation of business activity as shown. Both indexes are extended into 1935 merely to illustrate the hypothesis that 1934 "push-ups" must be compensated for by smaller annual increases in 1935, 1936 and 1937 for both business and local kilowatt-hours. See Figs. 5, 6 and 8 also.

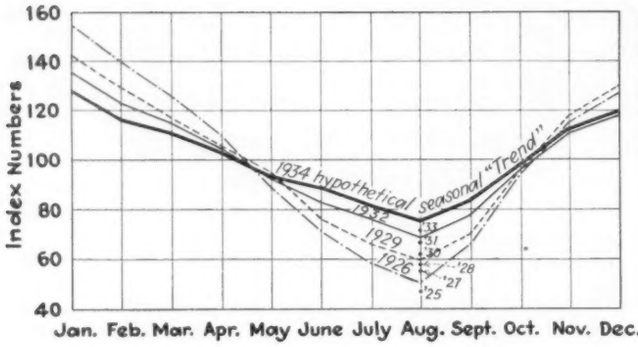


Fig. 10—Seasonal variations of local residential kilowatt-hour sales

The second method of short-term forecasting employs an annual seasonal index independently derived for every year to show change in seasonal characteristics. The residential seasonal (V-curve) is becoming flatter each year due to rapid increase in domestic refrigeration load.

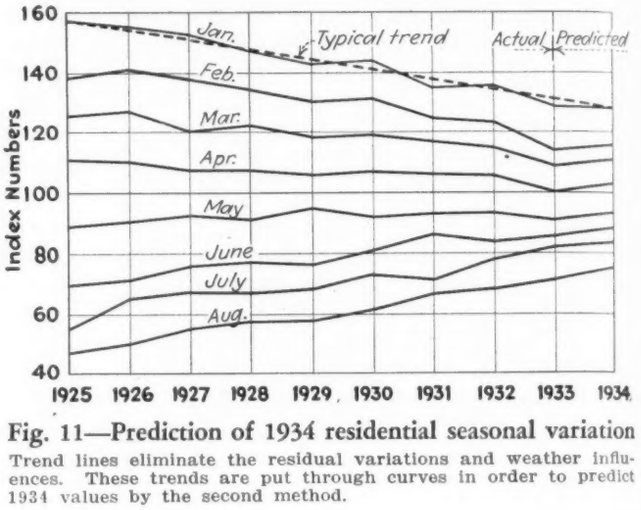


Fig. 11—Prediction of 1934 residential seasonal variation

Trend lines eliminate the residual variations and weather influences. These trends are put through curves in order to predict 1934 values by the second method.

was found to indicate the following phenomena. The average lag between the local kilowatt-hours and the U.S.A. business index increases to a maximum of nine months in the two depression years 1921 and 1932. The amplitudes of the cyclical variations of the kilowatt-hour index relative to the business index decrease when the cycle reverses from down to up or up to down, as in 1921, 1923, 1924, 1927, 1929 and 1932.

The correlation is further emphasized when the residual variations are freed from cyclical variations, as presented in Fig. 9. By this last step the disturbing factor of varying cyclical amplitudes is eliminated and the road is clear for the forecast, which is, as far as this first method goes, mainly concerned with obtaining the residual variations of kilowatt-hour sales from U.S.A. business. The forecast of the residual variations is the crux of this method, and having this it is only necessary to retrace the steps backward through cyclical variations, seasonal variations and long-term trend to the absolute forecast values of monthly total kilowatt-hour sales. From these the monthly sales for the classes are derived using similar procedures. In this sense the method can be called a deductive method.

Inductive method emphasizes local factors

The second or inductive method is quite independent of the first. It differs fundamentally from the previous method in its definition of seasonal variation. There the seasonal variation is an average of ten years, whereas in this case it is individually obtained every year, as a percentage of the average monthly value for that year, with growth removed. Obviously, this definition will result in different seasonal variations for every year, which will not only contain the influences of weather but also the residual variations described above. After removing this seasonal variation from the original data the cyclical variation remains, in the form of a straight line during the year, with no residual variations superimposed on it. This represents the annual growth and is obtained from the difference of the annual 1933 and 1934 values. But besides weather influences and residual

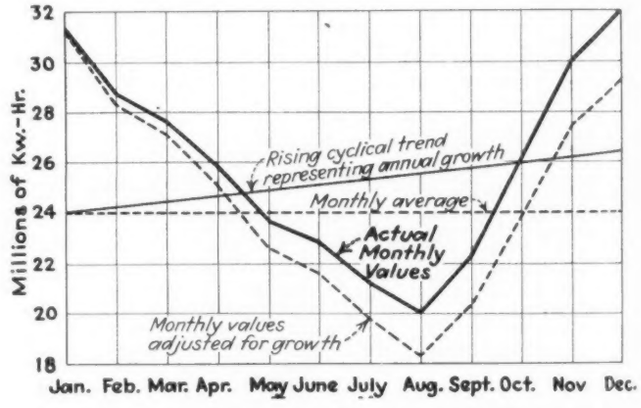


Fig. 12—Superimposing residential seasonal variation on straight-line cyclical trend

The last step in the second method is to combine the 1934 seasonal variation, as obtained in Fig. 11, and annual growth to obtain absolute monthly values for 1934.

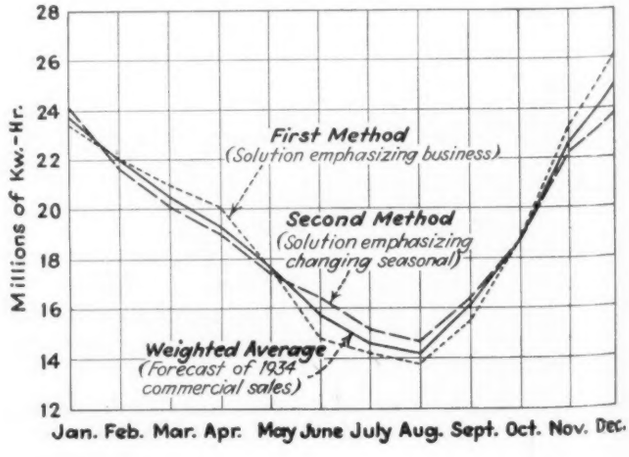


Fig. 13—"Weighting" of the two solutions forms 1934 monthly forecast of kilowatt-hour sales

In the commercial class equal weight is given to each method. For other classes the weight varies according to whether "business" or the change in seasonal characteristics is thought to have the greater influence. Finally, the "weighted" averages of the two methods for each component classification of sales (residential, commercial, large power, etc.) are added to obtain the 1934 forecast of monthly total energy sales for the locality.

variations another element is contained in this type of seasonal variation, namely, the progressive change in seasonal characteristics themselves, which constitutes the outstanding feature of this method. Fig. 10, showing the residential seasonal variations for some years past, will demonstrate how the seasonal variation itself is subject to change, the explanation in this case being the increasing use of the electric refrigerator at a rate of 25,000 units per year for the past six years.

To make this progressive change stand out better the seasonal variations are plotted in a different manner in Fig. 11. By extrapolating these curves a hypothetical seasonal variation for 1934 is evolved, shown in the customary form in Fig. 10, which is finally superimposed on the straight-line cyclical trend, Fig. 12. The process of drawing trend lines through these monthly curves eliminates the residual variation, which is unpredictable for this method, along with weather influences, and therefore these trend lines measure solely the effect of the change in seasonal characteristics from year to year. For the other classes monthly values are obtained in the same way.

Final result is weighted average of two solutions

Thus, there are finally available two sets of values of monthly kilowatt-hour sales for each of the classes of consumers. They are found not to differ very widely. As the last step of this forecast a compromise between them is made. According to whether the influence of business was considered to be preponderant, as in large power and small power, or the influence of changing seasonal characteristics, as in the residential class, the greater weight is given to the method expressing those particular factors. In the municipal and commercial class each method is given the same weight as illustrated for the latter class by Fig. 13. After the compromise between the monthly values for each of the classes they are added to obtain the final monthly value of total kilowatt-hour sales. In terms of the total kilowatt-hour sales the influence of business is given about 60 per cent weight and the change in seasonal about 40 per cent.

Forecasting is a continuous job

Arrival at these predicted values of the 1934 monthly kilowatt-hour sales does not complete the task at hand. It must be understood that at best forecasting is not a precise accomplishment, but rather it is the collection and interpretation of a considerable number of more or less unrelated factors and, with these in hand and the aid of good judgment, predicting the future. During the coming years it appears that since the government has entered the business world on a large scale our attention should be focused on such activities and their effects on local conditions. Due to the present uncertainties of governmental moves any forecaster should be in close touch with major changes and from time to time revise his predictions accordingly. There can be no magic involved, but only the exercising of continuous and untiring efforts to produce as complete and accurate a prognostication as is possible.

The prediction of 1934 business activity, previously outlined in this article, was derived in November, 1933, establishing an annual index value of 86.5. This estimate of the index has very recently been confirmed and enhanced by the index value of 85.0, as incorporated in the President's annual message to Congress in January.

Results of Better Light, Better Sight Program

By FRANK B. RAE, JR.
Cleveland, Ohio

Slightly more than 76 per cent of all cities in the country of over 10,000 population engaged in some sort of lighting promotional work as a result of the Edison Electric Institute's program of stimulation designated as the "E.E.I. Lighting Activity." This figure is taken from data secured by district offices of the incandescent lamp department of the General Electric Company reporting upon 98 per cent of 985 communities listed.

The institute's promotion, suggested by George E. Whitwell, vice-president of the Philadelphia Electric Company and chairman of the E.E.I. sales committee, was announced at the Chicago convention in June and swung aggressively into action in September. Though originally planned to last but 60 days, it is still carrying on with every indication of becoming a permanent program of lighting sales effort.

Some of the secured results beggar belief. In one town where an all-employee lamp campaign was undertaken one man sold twelve times his quota, another eleven times, another nine times. In a similar activity a meter reader sold 4.8 lamps per meter in his territory. An over-the-counter lamp agent reported sales increases of 505 per cent as compared with sales during the same period a year ago. A department store jumped its turnover of shades and portables by something over 300 per cent, another department store, unaided by the utility, in 60 days sold 2.23 lamps per customer in its community. One manufacturer sold a third of a million wall portables.

Nor were results confined to sales of lamps and inexpensive portables. The report reads that 602 of the 985 communities engaged in commercial lighting activities. Philadelphia's non-selling employees uncovered 4,140 commercial lighting prospects, of which number 1,650 were closed during the months of October and November for something like an added kilowatt of connected load each. In Warren, Ohio, which has only 1,557 commercial meters, there were sold 389 commercial lighting fixtures and 85 window lighting reflectors in 46 days. A salesman in small communities in Pennsylvania sold 93 high-priced store fixtures as a result of only 31 "cold canvasses." Down in Paducah they increased one factory's lighting load 900 per cent.

To the E.E.I. lighting program committee, composed of Merrill E. Skinner of Niagara Hudson Power Corporation, J. F. O'Brien of Westinghouse Lamp, Freeman Barnes of General Electric and C. E. Greenwood of the staff of Edison Electric Institute, must be given much of the credit for this widespread and successful activity. The tabulated results of its efforts in 985 communities of 10,000 population or over show:

751 conducted lighting activities of some sort;
522 conducted lamp sales activities;
602 conducted commercial lighting activities;
477 conducted home-lighting activities.

The above figures do not include a part of the state of Indiana, which doubtless would add slightly to the totals.

November Output Over Last Year's; Revenue Less

Notwithstanding the pronounced increase in energy sales during the last half of 1933 compared with the preceding year, the revenue of electric light and power companies has not only failed to show an equivalent increase, but has lately fallen off for corresponding months in the two years. During the middle of 1933 moderate gains began to appear, but October figures for the country as a whole were slightly under those for the same month in 1932 and the returns for November show a disparity of 1.7 per cent, with a total for the month of $165,890,000. Operating expenses, $70,580,000, were 2.0 per cent more than they were a year ago.

Partially compensating this unfavorable showing, the rise which normally occurs in the second half of the year set in much earlier in 1933 than in 1932, for the reversal began with June instead of September. In the year recently ended November revenue was 10 per cent greater than May, whereas in 1932 it was only 6 per cent larger.

As a whole the statistics indicate a continuous lowering of the average rates for energy and an upward tendency as to cost of operations, presumably due to code requirements and, in part at least, to a marked increase in the amount of energy that had to be generated from fuel, compared with 1932.

Energy production, 6,754,000,000 kw.-hr., exceeded last year's by 4 per cent, but the hydro-electric output was down 14.2 per cent and fuel-generated energy gained 16.7 per cent. This latter made a difference of more than 600,000,000 kw.-hr. and called for an increase of 450,000 tons of coal or its equivalent over the quantity burned a year ago.

The contrast between the increase of energy production and decrease of revenue is especially to be noted in the Northeastern and North Central parts of the country. While the kilowatt-hour figures indicate a continuation of the industrial activity, it is evident that the light and power companies did not benefit proportionately as to financial returns. In general, domestic and commercial retail energy consumption has been approximately the same, month by month, as in 1932. Rates have been coming down. The decrease in revenue has not been fully balanced by the larger sales to wholesale consumers. The only section reporting energy consumption far ahead of the preceding year's was the Mountain region.

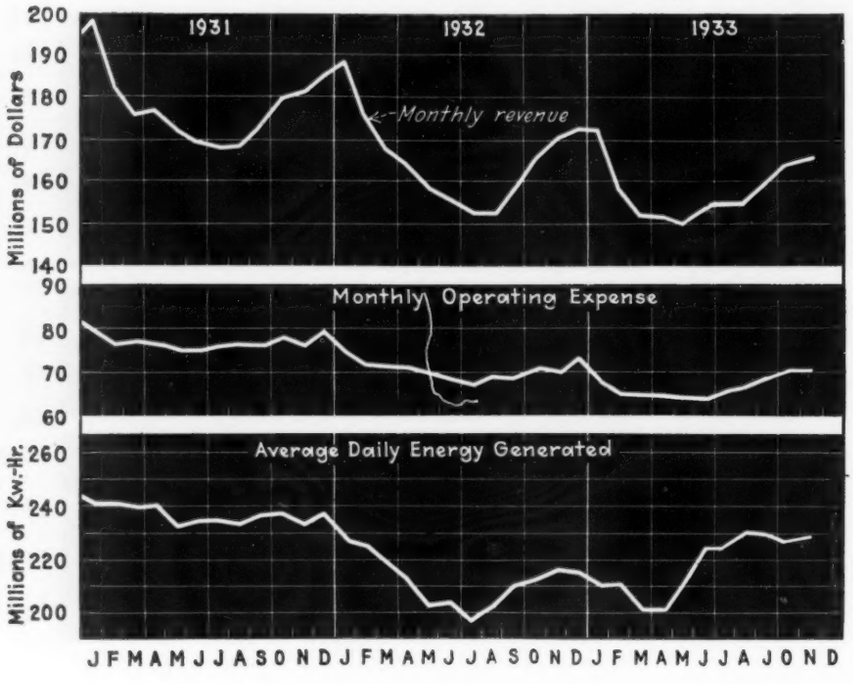


Table I—Energy Output of Central Stations in the United States

Compared with Corresponding Month of Previous Year

Month 1933	Generated, Thousands of Kw.-Hr.*						Purchased for Resale	
	Total		Hydro		Fuel			
	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Thous. Kw.-Hr.	Per Cent Inc.
August	7,212,325	+13.8	2,702,735	+12.8	4,509,590	+14.3	1,982,000	+ 7.8
September	6,908,017	+ 9.6	2,713,810	+21.6	4,194,207	+ 3.2	1,994,000	+ 6.2
October	7,037,289	+ 7.0	2,435,162	− 2.5	4,602,127	+12.5	2,068,000	+ 1.2
November	6,754,081	+ 4.0	2,304,555	−14.2	4,449,526	+16.7	1,914,000	+ 1.3

Table II—Regional Revenue, Energy Output in November, 1933

Compared with Corresponding Month of Previous Year

Region	Revenue		Energy Generated, Thousands of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.	Generated	Per Cent Inc.
United States	165,890	− 1.7	6,754,081	+ 4.0	2,304,555	−14.2	4,449,526	+16.7
New England	17,940	− 0.5	503,338	+ 8.8	214,144	−24.2	289,194	+61.1
Middle Atlantic	43,740	− 2.2	1,761,409	+ 6.2	459,702	−15.8	1,301,707	+16.8
East North Central	38,660	− 1.9	1,613,875	+ 7.6	130,366	−15.0	1,483,509	+10.3
West North Central	13,610	− 3.2	424,861	+ 2.8	81,021	− 0.6	343,840	+ 3.7
South Atlantic	18,510	+ 0.5	761,913	− 9.5	341,254	−39.7	420,659	+51.7
East South Central	5,340	− 3.6	253,658	− 6.0	202,838	− 9.0	50,770	+7.2
West South Central	9,990	− 1.2	338,960	+ 1.0	7,078	+49.0	331,882	0.0
Mountain	3,900	+ 1.1	228,675	+28.0	182,355	+37.5	46,320	0.0
Pacific	14,200	+ 0.7	867,392	+ 3.5	685,797	− 1.0	181,595	+25.4

*By courtesy of U. S. Geological Survey, with deductions for operations not regarded as central-station

Table III—Central-Station Financial Operations in the United States

Compared with Corresponding Month of Previous Year

Month	Total Gross Revenue from Sale of Energy*		Total Operating and Maintenance Expense†	
	1933 Thousands	Per Cent Inc.	1933 Thousands	Per Cent Inc.
August	$154,930	+ 2.0	$66,420	+ 0.8
Sept.	160,080	+ 1.5	68,060	+ 4.5
Oct.	163,940	− 0.9	70,330	+ 1.5
Nov.	165,890	− 1.7	70,580	+ 2.0

*Aggregate gross revenue from consumers and from other utilities for energy for resale, involving a certain amount of duplication.

†Does not include interest, taxes, depreciation or sinking fund, with some unavoidable exceptions.

Wiring of Machine Tools Needs Attention

By D. K. FROST
Electrical Engineer Mattison Machine Works, Rockford, Ill.

Very frequently, or perhaps most frequently, the wiring on machine tools is a particularly noticeable feature because it is so conspicuous. The conduits, junction boxes and electrical fittings obtrude themselves on the attention. Usually no thought at all is given to the wiring and the final arrangement is left to the wireman's fancy. Electrical wiremen can generally be depended upon to do a good job from a safety standpoint, but not necessarily a good looking job, especially where no preliminary details have been worked out.

STEPS can be taken not only to improve its general appearance but at the same time provide more adequate protection to the wiring of machine tools. In the first place, presuming that the size, type and location of motors and control equipment have been determined, a complete wiring diagram should be made up. In this wiring layout the motors, control panels and accessories should be placed as nearly as possible in the relative positions they will occupy on the machine itself. The importance of this cannot be too strongly emphasized, and the reason will become apparent as the work progresses.

Electrical manufacturers should be freely consulted. They can aid by making suggestions on the wiring, or even by furnishing the wiring diagram. More important, however, they can advise as to the location of terminal wires on the electrical apparatus to fit the location of the apparatus on the machine. As an instance of this, electrical motor manufacturers have a standard location of motor terminal boxes. This is generally the left-hand side facing the pulley end. Motors can just as readily be furnished with the terminal box on one side as on the other, but this detail must be given on the order, otherwise the standard arrangement will be furnished.

Control inclosing cases have, as a rule, knock-out holes in the top and bottom plates. Due to insistent demands of certain machine manufacturers, knock-out holes are now being furnished in the back plate also. This, at least, shows a desire on the part of some manufacturer to do away with unsightly conduit fittings, which are necessary when bringing out conduits at the top and bottom plates.

The next best arrangement to building the control into compartments in the main castings is to mount the inclosing cases on the castings and run the wiring through the back plates into the machine and locate the wires or conduits on the inside rather than the outside surfaces of the machine castings. Limit switches and master switches may be assembled for right-hand or left-hand operation, with terminal fittings to match.

Concealed wiring improves appearance

Having the wiring arrangement before them, machine designers can proceed to make proper provision for the wiring. It is surprisingly easy to provide for concealed wiring if it is known where the wires must be run, but it is difficult, if not impossible, to do this if no wiring diagram is available. The appearance of the machine is not only improved by running the wires inside but it is also cheaper. Solid or flexible conduit costs from 5 to 25 cents a running foot, depending on the size, and the supporting straps and other fittings must be included in the cost. It is permissible and safe to provide wiring troughs or wire-ways in the castings themselves and do away with all but a very few short lengths of conduit.

A very neat arrangement under a ledge or other out-of-the-way part is to provide U-shaped depressions in the castings and cover these with sheet-metal covers. Another way is to use lead-covered cables fastened to the inner walls of the castings. When protected from mechanical injury, lead-covered cables offer the best possible protection against oil, grease and moisture of any kind. A few handhole covers at advantageous locations make these cables fully accessible. Some machine tool builders now use flexible steel conduit over ordinary rubber-covered wire, with the idea that they are fully meeting requirements. This is not true. In flexible conduit lead-covered cable is required to afford protection against oil, vapor or metallic dust. Where ordinary rubber-covered wire is used flexible conduit offers mechanical protection only, as flexible conduit is neither liquid nor dust-tight.

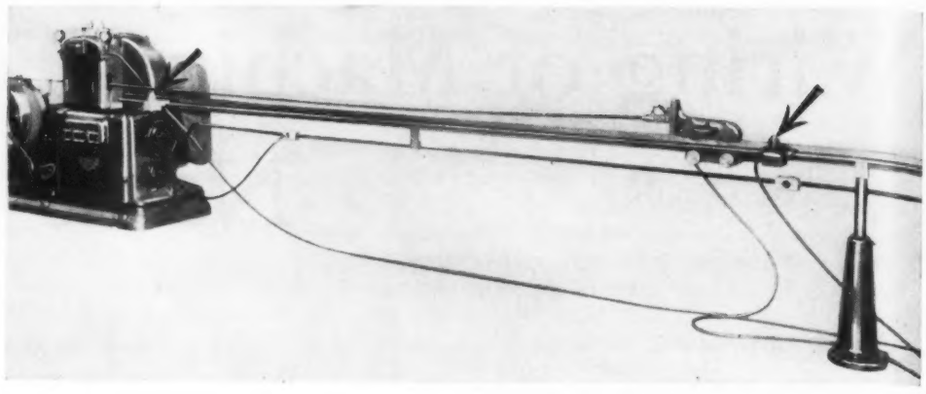
When it is definitely known just where connecting wires must be located it is entirely possible for the designer of the machine to provide cored holes through inside supporting ribs or across members inside the castings. This method of running fixed wiring on inside surfaces has proved in every case to be much cheaper and better in every respect, provided it is planned in advance.

Connections to moving parts

Possibly the greatest difficulty in wiring is found where a number of wires must be run to a motor or motors on a moving carriage or a moving head, especially where the

Loop connection to long stroke movement

The ram on this internal tube grinding machine is operated by a reversing motor. The travel of the ram is adjustable to any length between 10 and 30 ft. by means of an arrangement similar to the limit stops on a typewriter carriage. The limit heads, indicated by arrows, are movable along the ram track and contain reversing switches which may be plugged in at three points along the track.

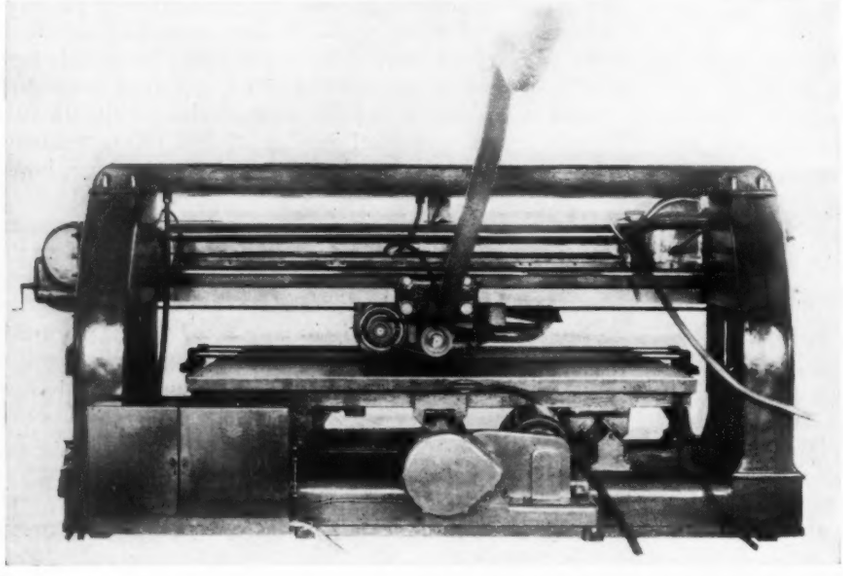


moving member must travel some considerable distance. One method is to use so-called type S hard-service rubber-covered cable. The outer portion of the jacket on this cable is made of high-grade tough rubber, similar to that used for treads of automobile tires. This type is claimed by its manufacturers to withstand water, oil and grease and to stand more mechanical abuse without injury than any other type of cable. For short movements this cable can hang in loops and allow movement back and forth continuously. For longer movements it becomes advisable to use spring-operated take-up reels of substantial construction. A method of taking care of a 30-ft. movement for a reversing ram is shown in one of the accompanying illustrations. The movement must be adjustable between a minimum of 10 ft. up to a maximum of 30 ft. This is provided by a series of three twist lock plugs and receptacles, which allows the control wires to be plugged in for any desired length between the minimum and maximum.

The cable on the grinder illustrated allows a movement of 12 ft. back and forth continuously. This cable carries wires for a fairly large motor on the reversing carriage. The cable on the left, near the column, carries fifteen control wires from the panel to the push-button stations, which, for convenience, are mounted on the moving table. Where a motor or motors are mounted on a machine part which revolves it is a simple matter to use collector rings and carbon brushes to supply the current for the motors on the rotating part. It is necessary fully to inclose the collector rings and brushes in a housing, or at least protect them in such a way that the contact surfaces can be kept clean and operators prevented from coming in contact with the line parts.

For control circuits it is not permissible to use wire smaller than No. 14. This wire, either solid or stranded, is available with covering braids of many different colors. It is good practice to use different colored wires for specific control circuits. For instance, green-covered wires for start-button circuits, red for stop-button circuits and yellow for common or neutral circuits. This saves considerable time in wiring, as it is not necessary to ring out such wires. It also aids in tracing out various circuits in case of trouble. This color scheme can be and is carried out for other specific control uses. It would be a good idea for electrical manufacturers to standardize different colored wires for certain specified control circuits, which is done by some manufacturers, but there is no standard practice except for particular companies. It is noticeable that this method of tracing wires has been used with good results in radio and telephone switchboard circuits and it might well be adopted in industrial wiring.

It is my belief that there are certain mistaken ideas about necessities for meeting National Electrical Code rules. The following comments should not be interpreted in any way to criticise the wiring code. The new 1933 issue of the code, effective November first, has just been issued. This publication is the outgrowth of many years' experience and is, in fact, a criterion of acceptable



Flexible attachment to grinding head

On this machine the grinding head carriage moves back and forth across the table, a distance of about 12 ft. The table reciprocates in 4- to 5-ft. strokes normal to the movement of the grinding head. The cross rail carrying the grinding head carriage can be moved up and down 10 to 12 in. It is to be noted that, except for the flexible connections to moving members, all wiring is contained inside of the machine castings. About 1,500 ft. of conductor is required to wire this machine. The large pipe rising from the grinding head is for air suction to remove metal and abrasive dust. The two leads at the bottom, right, are not electrical connections, but are hoses for water used to cool the grinding table.

wiring installation methods. Its purpose, of course, is chiefly to cover fire hazards, but during recent years the personal injury hazard has had increased consideration. The code includes substantially all necessary safeguards to wiring that are generally advocated or recognized for both fire and shock hazards.

Strange as it may seem, there is no specific code that pertains to the wiring on machines. The National Electrical Code as written applies to the wiring of dwellings, buildings and industrial plants. In industrial plants it applies up to and including the line leads to the machines. It is true that many of the rules and regulations of the wiring code may well be applied to the wiring on machines. For example, the size and type of wire should be selected from the tables in the code. The inside diameter of conduits for a given number of wires may be selected from the code tables. In this connection, however, it should be pointed out that the conduit sizes given are determined for long runs and are amply large to allow "fishing" the wires through easily, even with several bends. It will be found that for short runs on machines some sizes given in the tables are out of proportion. Smaller size conduits can just as well be used with equally good results and not be out of harmony with the code, because, as pointed out above, the code applies to general factory wiring and not specifically to machine wiring. In fact, there is a note preceding the code table of conduit sizes which explains that the tables apply only to complete conduit systems, and do not apply to short sections of conduit used for the protection of exposed wiring from mechanical injury.

As another example, the code requires an individual line disconnect switch for each motor. Some machine manufacturers have taken this literally and attempt to have a line disconnect for each motor on the machine, even though there may be four or five motors involved. Ultimate users of machines with mistaken ideas of the code have insisted that such switches are required. Nothing further from the actual requirements could be conceived. Lately, the authorities of the code have recognized these misunderstandings and have liberalized and explained some of these situations. As a matter of fact, they recognize that in the case of a large machine tool driven by two or more motors a single disconnecting means is more desirable than individual switches for each motor. Some one might forget to open one of the many switches. Repair and maintenance work can be done with far greater safety when the entire electrical equipment is "dead."

Where a single fused disconnecting switch is used it is not necessary to fuse separately the various motor branch circuits. The rule for a group of motors is as follows:

> When, in a group of motors, each is protected by a motor-running protective device (thermal overload relay) which has been approved for a group installation, the motor branch circuit protective devices (fuses or circuit breakers) may be omitted provided the feeder conductors supplying the group are protected by fuses having a rating not exceeding that indicated on the smallest motor-running protective device of the group, and also provided the motor branch circuit conductors up to the motor-running protective device have either (a) the same current carrying capacity as the feeder or (b) at least one-third the current-carrying capacity of the feeder, the conductors to the motor-running protective device in the latter case being not more than 25 ft. long and being suitably protected from mechanical injury.

Thus it will be seen that group wiring of motors is recognized as satisfactory if certain rules are followed in regard to suitable protection of the various conductors in the branch circuits.

Grounding is important

It is generally understood that interior conduit systems, armored cables, inclosing cases for control, etc., shall be metallically joined together into a continuous electrical conductor. Moreover, this circuit must be efficiently grounded. This, of course, is for fire protection. The contained interior wiring of the conduit systems should also be grounded in accordance with standard grounding arrangements as covered by the code.

As for the machines themselves, the code does not state specifically that machines must be grounded. However, as a safety measure, all machines should be grounded. We make a practice of providing a large wiring lug securely bolted to the frame of each machine, and in the book of instructions point out the advisability of running a grounding wire (not smaller than No. 6) from this lug to the nearest water pipe or good ground connection. This not only takes care of annoying or dangerous shocks to workmen around the machine but also carries off static electricity which might be occasioned by friction surfaces. The static electricity from belts is often very annoying and can be entirely eliminated by hanging tinsel over and just touching the belt and grounding the metal rod from which the tinsel hangs.

Fusing control circuits

According to the code, it is not necessary to fuse the branch control circuits to push buttons, master switches, etc., when the motor-control device and the point of control (start and stop buttons, master switches, etc.) are both located on the same machine. It will be found, however, that the codes of certain states (California, for instance) require that branch control circuits be fused for No. 14 wire, which requires at least 15-amp. fuses. We have made a practice of always fusing control circuits, because we have found that a short circuit in the control circuit can do a great deal of damage to relay contacts, coils, interlocks, etc., if not protected. The control circuit, however, should not be fused where the opening of the control circuit would create a hazard, as, for example, the control circuits of fire pump motors, etc. On machine tools there is usually no hazard introduced if the control circuit is opened unexpectedly. However, this point should be taken into consideration.

Of course, there are many other conditions in group circuits which must be safeguarded, but the foregoing are the principal items that must be watched. Because of the widely differing motor sizes in group installations on a machine tool each case must be considered separately and no general rules can be stated to cover all cases. As a matter of fact, however, the machine tool manufacturer should not have to worry about disconnecting switches, etc., as they are part of the shop installations. Outside of providing the correct size and type of conductors and suitably protecting them from mechanical injuries and local conditions of oil, cutting compound, metal dust, etc., the main object should be to make machines self-contained and of good appearance, with motors, control and wiring as safe as it is possible to make them both from the standpoint of the operator and the machine itself in various functions of the operating cycles.

THIS WEEK'S NEWS

Electrification to Absorb 78% of Pennsylvania's $77,000,000 Loan

ACCEPTED by government and railroad officials as the most extensive program of its kind to have been undertaken by any American railroad in many years, the Pennsylvania system this week announced through President W. W. Atterbury just how it would dispose of its PWA loan of $77,000,000. Electrification work will take $60,000,000, or about 78 per cent. Other rolling stock and terminal facilities for Newark, N. J., and Baltimore tunnel work account for a large part of the balance. General Atterbury estimates a total of 45,000,000 man-hours of employment to be represented, the equivalent of a year's employment for 25,000 men. Primarily an expenditure for the capital goods industries, where stimuli are most needed at present, the program is a definite recovery measure.

A 646-mile electrification

The first step in electrification will be the completion of the line from Wilmington, Del., to Washington, a distance of 108 miles; the electrification of seven branches and connecting freight lines and related improvement work, between New York, Philadelphia, Baltimore and the capital. This extension of the electric zone and the branches will take $45,000,000 and will mean that a total of 646 miles of track will be electrified. Incidental to this work will be a re-arrangement of roadway signalling systems, construction of sixteen new substations and installation of new equipment in eighteen others. All telephone, telegraph and signal lines in the new construction zone will have to be relocated from poles to underground cable and track, platforms and bridges changed for the greater speed and overhead clearance.

$15,000,000 for equipment

The second step in the electrification program will be the construction of 101 electric locomotives, 59 freight, 28 passenger and 14 switch engines. This, one of the largest engine programs in railroad history, will cost $15,000,000, to go primarily to electrical equipment and locomotive companies. The new engines will be of the same type as those recently built, but with such improvements that the normal speed of the passenger trains will be raised by 25 per cent, from 75-80 miles per hour, at present, to 100 miles per hour. This will be the speed looked to in all the improvements.

General Atterbury pointed out that the loan will be entirely paid off in from 15 to 30 years and that interest will be 4 per cent. Operating savings anticipated are expected to enable the railroad to earn 4 or 5 per cent over the carrying and amortization charges. On the basis of present power contracts, the company expects its power rate to be shaved from 9 mills at present to 6½ mills per kilowatt-hour, when the plan is completed. General Atterbury does not look for a major trend to railroad electrification at this time, it being his contention that electrification is justified only for divisions with concentrated traffic such as on the Pennsylvania's New York to Washington line.

Pacific Gas & Electric to Stimulate Energy Sales

With a 1933 quota achievement of 126 per cent, representing new load estimated to produce $4,345,127 in annual electric revenue, Pacific Gas & Electric Company has announced 1934 sales plans estimated to add 82,395 kw. in new load exclusive of domestic appliances and $3,529,622 in new revenue. According to R. E. Fisher, vice-president, the 1934 program will involve expenditures of approximately $1,500,000, including advertising, of which 60 per cent will be devoted to developing electric business and the balance to the gas department.

Appliance quotas announced include 4,600 electric ranges, 3,000 water heaters, 2,000 major air heaters, 5,000 auxiliary air heaters and 21,000 lighting units. In other new-business classifications quotas call for 5,560 kw. in commercial and industrial lighting, 7,480 kw. in new residential lighting, 739 kw. in street lighting, 50,883 kw. in commercial and industrial power, 5,300 kw. in industrial heating and 17,433 kw. in agricultural power.

Special wiring allowance

As a means of stimulating electric range sales the 1934 program includes a wiring allowance offered in exchange for a competitive fuel range (not gas) to consumers who own and use such a range. The allowance, only available to single-family dwellings, is $40 for range wiring, $20 for installation of a water heater and $60 for both. The company will absorb half the wiring charge where similar sales are made by dealers. In addition a flat wiring charge has been worked out with electrical contractors in all territory served. A liberal trade-in allowance will be made for the purpose of removing old electric ranges from the lines of the company.

Vice-president Fisher reports that on the Pacific Gas & Electric system average domestic energy consumption in 1933 was 733 kw.-hr.; average domestic revenue $32.71.

•

Rice Lake Switches Utilities

Under the terms of a new ten-year power contract drawn between Rice Lake, Wis., and the Northern States Power Company the city will save $80,000 a year. The contract took effect in January, when the present contract, which still had a number of years to run, was surrendered. Construction of a new power line from Jim Falls to Chetek has been started. The company now buys power from the Wisconsin Hydro-Electric Company.

Michigan Commission Row Carried to Attorney-General

Continuing his long-sustained fight to oust the Michigan Public Utilities Commission (ELECTRICAL WORLD, January 13, page 92), Governor Comstock of Michigan called the five members of that body to his office last week to request their resignations in accordance with his announced plan to consolidate the commission's duties with other present functions of state officials. Only three members were able to appear and they refused to resign, indicating that they would fight any attempt to remove them before their terms expire June 13, 1935.

Following the refusal of three members to resign, the Governor announced: "On grounds of political expediency and public demand I have asked for their resignations. They have refused, so, under the powers given me by the Constitution, I am asking the Attorney-General to hold a public investigation of the commission."

Under either of two statutes the Governor has power to remove the commission. One is general, referring to malfeasance and misfeasance in

office. The other refers only to willful neglect of duty and official misconduct. The Governor announced that he would proceed under the general statute. The chairman, Kit F. Clardy, announced he would "fight with brass knuckles." Harry C. McClure and Robert H. Dunn were the other commissioners present. Harold J. Waples has announced that he would resign if the Governor desired. So has Edward T. Fitzgerald, who for months has been at loggerheads with other members. All are Republicans.

•

Oregon Commissioner Acts

Charles M. Thomas, Oregon public utilities commissioner, has ordered a reduction in salary of all Oregon officials of Pacific Power & Light Company, Portland Gas & Coke Company and Northwestern Electric Company, and refused to allow payment of $100,000 by the three allied firms to the Electric Bond & Share Company.

The three utilities had protested against the commissioner's passing upon their budgets for 1934. Thomas insisted he was empowered to do this by a legislative act of 1933.

The commissioner's order eliminated the $7,800 retirement salary of Guy W. Talbot. Paul B. McKee, president of the three companies, was ordered to take a salary cut from $29,160 to $15,000 annually.

The Oregon law gives the state utilities commissioner power to regulate and supervise rates, services and practices of all utilities except those municipally owned.

Knoxville Would Buy Out Utility

MAINTAINING only one of three proposals made by Tennessee Public Service Company to be worthy of consideration, that for the purchase of its facilities by Knoxville (ELECTRICAL WORLD, January 27, page 163), City Manager W. W. Mynatt, under instructions from the City Council, is prepared to negotiate with the Tennessee Valley Authority for a contract to supply T.V.A. power to the city's proposed municipal electric power system. Following a preliminary conference with David E. Lilienthal of T.V.A., who was found ready and willing to discuss terms of contract, Chairman Cockrum of the Council power committee stated that the Council had no authority to lease a distribution system. "And as to the proposed rate reduction, we see no reason why the company should not make that anyway," he said. "We would be glad to see a reduction in rates and we have tried to obtain them for years. But we believe purchase of the system is the only item we can consider because Knoxville is an integral part of the Tennessee Valley development and any rate reduction agreement or lease would not be satisfactory. . . . The committee also feels there should not be duplicate systems, but only one plant, and that plant owned by the city. The city is ready to receive a definite proposition from the Tennessee Public Service Company on the sale of its distribution system, but . . . it must be made at once."

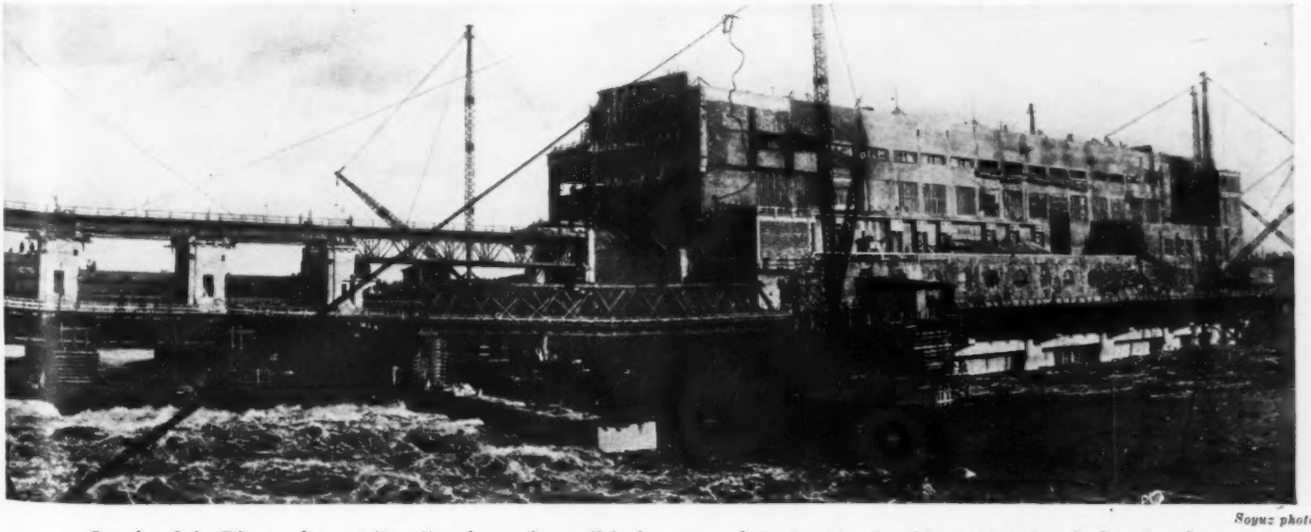
Beginning at one minute after midnight of February 7, T.V.A. electricity delivered over lines acquired from the Mississippi Power Company will light the homes and turn the wheels of industry in the city of Tupelo, Miss., the first municipality to contract with T.V.A. for electricity (ELECTRICAL WORLD, November 4, page 580).

P.W.A. backs few municipals

Despite many applications filed with the Oklahoma advisory committee of the federal Public Works Administration for loans and grants for electric light and power plants and distribution systems to be municipally owned, citizens do not seem to be backing up the idea by votes. Projects have been turned down at Norman and Pawnee and withdrawn at Mooreland as far as bond issues are concerned. One of the largest projects of municipal ownership proposed in Oklahoma, that for the city of Muskogee, was dropped when the Public Works Administration ruled against a suggested contract which would permit repayment of a loan out of earnings of the utility. Cushing has been granted a federal loan of about $350,000, but any proposition for a municipal light and power plant bond issue must go to another vote.

Kennett, Mo., has been allotted a loan and grant amounting to $150,000 for the construction of an electric power plant, including the installation of three 220-kw. Diesel-driven generators. The approximate cost of labor and material is $120,000.

150,000-HP. HYDRO FOR LENINGRAD



Soyuz photo

On the Svir River, about 145 miles from the political center of Soviet Russia, this 150,000-hp. hydro-electric station is nearing completion. Less powerful and less talked about than Dnieproges, Svirstroy will be of importance not only for power but for navigation control. Built at the rapids of the Svir, it will open the river to full waterway transport

Coming Meetings

Canadian Electrical Association, general conference of Committees—Montreal, Que., February 5. B. C. Fairchild, 409 Power Bldg., Montreal.

American Society of Heating and Ventilating Engineers—New York, N. Y., February 5-8. A. V. Hutchinson, 51 Madison Ave., New York.

Oklahoma Utilities Association—Tulsa, Okla., March 6-7. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City.

American Society for Testing Materials—Washington, D. C., March 7. C. L. Warwick, 1315 Spruce Street, Philadelphia, Pa.

Missouri Association of Public Utilities—Excelsior Springs, Mo., April 19-20. N. R. Beagle, 101 W. High St. Jefferson City, Mo.

Electrochemical Society — Asheville, N. C., April 26-28. Colin G. Fink, Columbia University, New York.

Power Commission Asks Holding Company Control

Federal control over holding companies and affiliated service companies dominating federal government licensees under the federal water power act was urged by the Federal Power Commission in its thirteenth annual report, just sent to Congress, covering the fiscal year ended June 30, 1933.

Citing the many obstacles with which it is confronted in its efforts to audit and classify costs of licensed projects where holding companies, which are beyond the jurisdiction of the commission, manage the affairs of the licensed projects, the report says: "Most of the licensed projects operated as public utilities are members of holding company groups. Through the method of intercorporate control by affiliated service companies, these holding companies manage and supervise the affairs of the licensees, including the financing and construction of the project. As a result, many items claimed by the licensee as a part of construction costs arise from intercorporate contracts thus imposed by common ownership and control, while the pertinent facts necessary to determine the legitimacy of such claimed items are either buried in the accounts of companies outside of the commission's jurisdiction and, therefore, not subject to its scrutiny, or are not to be found in any record at all. In certain cases the commission has found it necessary to reserve for further consideration fees and charges of affiliated companies whose validity as part of the project costs it has not been possible to determine on the record before it."

•

Georgia Power Strike Off

After three years of employee-company differences a strike of about 25 electrical workers of the Georgia Power Company has ended. Through an agreement just signed by the company and the local union, all who walked out will return to work; all union men will be eligible for employment and the company will recognize the union.

Iowa Utility Men Protest Federal Municipal Aid

Vigorous protests against the use of federal funds for the construction of municipal power plants to compete with existing light and power developments were voiced by various speakers at the recent Iowa Utilities Association meeting in Waterloo.

B. J. Price, president of the Iowa Public Service Company, declared experience to indicate that such loans would not only be lost to the government but that an equal amount of private capital would be destroyed and removed from the tax rolls. "Politicians ever have raised themselves into office by vilification of utility companies," he said. "Never has the effect of this practice been so dangerous as it is today. National, state and municipal administrations apparently have joined in a concerted effort completely to ruin an industry, the impairment of whose securities will work untold harm upon the savings, the life insurance, the employment and the morale of millions of our citizens. Unless this program of destruction can be arrested, there will be no need for conventions like this devoted to the promotion of sales and distribution of appliances and energy. The duty of every man in this convention is plain. The American people must be sold the case of the utility companies."

"Helping the Distribution Man Off the Spot" was the title of a paper read by Arthur Huntington of the Iowa Electric Light & Power Company, in which he discussed the problems of maintenance, particularly during the last few years, when money for this purpose was difficult to get. No matter what the financial difficulties are, Mr. Huntington urged that lines be maintained to the highest standard in order to insure proper public service. Frank R. Innes, Western editor of the ELECTRICAL WORLD, stated that the adventure of the federal government into appliance selling—Electric Home and Farm Authority—would, if anything, probably have a stimulating effect on load building all over the country.

•

Hartford Pension Plan

Pension plans of the Hartford Electric Light Company (ELECTRICAL WORLD, January 13, page 91), involving insurance for 700 employees and a premium of $100,000 to Aetna Life Insurance Company, have been completed. Employees join voluntarily by contributing a specified portion of their income. Should an employee leave the company before retirement age, or die, his contributions are payable to himself or heirs with interest, compounded at 3½ per cent. The retirement ages set are 65 for men and 60 for women and pension

SODIUM-VAPOR FLOODLIGHTS COME NEXT

International News

Following recent triumphs in the street-lighting field sodium-vapor lamps are now to be used in floodlighting. This is one of four identical 10,000-lumen units just installed on the outside of the General Electric Building in New York, where their glow floods the building and avenue with monochromatic yellow light. The units are mounted above the first floor level. The reflector shown has been fabricated of the new Alray aluminum (ELECTRICAL WORLD, January 27, page 165). According to General Electric engineers these tubes give three to four times the illumination obtainable with incandescent lamps for the same energy cost. Other installations are discussed.

depends on salary schedule. Allowances are made for absence from work and employment. There are optional methods of withdrawing benefits and optional insurance plans for individuals, joint husband and wife plans and employees' savings protection plans available.

Insull Gets Ten-Day Stay; Collusion Hearing Soon

Upon the plea that he is too ill to travel, the Greek Government this week granted Samuel Insull a stay of ten days before he must seek another haven. His residence permit was to have expired at midnight January 31, when, government officials had previously intimated, he would be expelled. Following the consideration of a physician's report by the Greek Premier and Interior Minister the extension was granted. Two government physicians who examined Mr. Insull found his heart was able to stand travel.

Middle West hearing due

Full and complete hearing upon charges of collusion in the Middle West Utilities receivership have been promised by Judge Lindley for February 6.

Suit for the recovery of $12,877,000 from officers and directors of Corporation Securities Company, a defunct Insull investment trust, and Halsey, Stuart & Company, has been filed in the Cook County Superior Court on behalf of Sam Howard, trustee of the bankrupt estate. Involved is the likelihood of a comprehensive analysis of the struggle between Cyrus Eaton and Insull and of other events leading to the Insull collapse.

The commission has a responsibility not only to the public but to the utilites, and through them to investors. Public utilities provide better service than would be possible under a system of competition and a citizen gets more dollar-for-dollar value in utility service than he does in buying any other commodity.

EDWARD J. HOPPLE,
Chairman
Ohio Public Utilities Commission

Addressing a Cleveland audience this week Mr. Hopple sided with public utility companies and against the "organized drive of hysteria" urging "that the utility question be considered apart from political expediency." "If we removed the demagog, racketeer and political opportunist, rate making in Ohio would improve rapidly and controversies would be settled," concluded Chairman Hopple.

Power Board Opposes E.E.I. Code; Rates and Competition Debated

CONTENDING that a code for the "non-competitive" power industry should be limited to the control of wages, hours and working conditions and should not include control of policies and trade practices, the Federal Power Commission in a brief filed with the NRA has formally expressed opposition to the electric light and power industry code submitted by the Edison Electric Institute and now under advisement by NRA. The brief is in support of objections previously presented by the commission's chairman, Frank R. McNinch, at a recent public hearing on the code (ELECTRICAL WORLD, January 13, page 90).

The electric light and power industry, the commission points out, is monopolistic in character, the element of competition being negligible and consisting of the competition of publicly owned plants, which contribute only 5.7 per cent of the total electrical output. The brief states that the proposed code will lodge control of the industry in the representatives, not of the operating companies, which are to be vitally affected, but in the large holding companies, which will select nine of the twelve members of the Code Authority. Publicly operated plants that participate in the code will constitute but an impotent minority, with only one vote out of the twelve on the Code Authority, which will exercise vitally important power and functions, affecting directly or indirectly the whole industry. "This concentration of control of trade practices and policies," the commission contends, "offers an opportunity to discourage and check the development of small, independent plants and publicly operated enterprises and to nullify the Administration's plan of establishing 'yardsticks' to measure the fairness of utility rates and services and to extend to rural areas the benefits of electrification." Opposition was also expressed to the provision in the proposed code for a power survey and formulation of a ten-year program to be conducted by the co-ordination committee on the grounds that it is in direct conflict with a presidential order of August 19, 1933, directing the Federal Power Commission to conduct a national power survey, already well under way.

Leave out rates, says E.E.I.

In a statement forwarded to the NRA offices in Washington, George B. Cortelyou, president of the Edison Electric Institute and chairman of the industry conference, and Preston S. Arkwright, chairman of the code committee of the institute and the industry, contend that adjustment of rates in the industry to reflect sharply increased costs is neither within the control of the members of the industry nor of the agencies of the NRA, but rests with the various public service commissions. Maintaining that the industry carries on its business of electric service pursuant to a public duty and obligation to serve adequately, safely and continuously, these officials stated that code provisions as to hours and wages for this industry are not to be determined by comparison with seasonal industries in which employment is casual or irregular.

Omit municipals, NRA demands

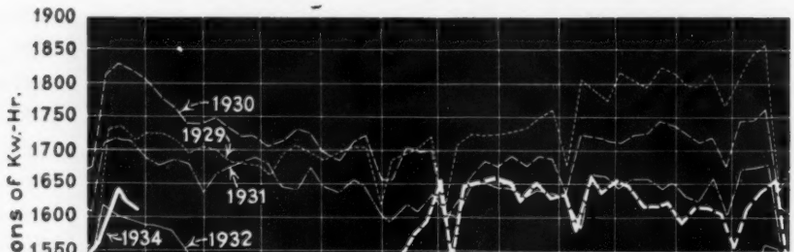
To clarify NRA's policy that no publicly owned utility should be coerced into coming under the power and light code, Donald Richberg, NRA counsel, has recommended that publicly owned utilities be excluded from clauses in the power code defining the extent of NRA's codification. As the code was presented at public hearings, the industry covered was defined as including all units of the power and light business. Mr. Richberg said he has been under the impression that NRA's position on the publicly owned utility units was clear, but that in the light of discussions at the hearing he had recommended to code proponents that the code be changed to avoid any appearance of attempts to include publicly owned power companies in the code except on a voluntary basis. Telegrams voicing objections of the city of Detroit to the placing of municipal power plants under the power code were sent last week by the Common Council to President Roosevelt, General Johnson and Secretary of the Interior Harold L. Ickes.

Bonneville Board Meets; Cost Division Discussed

Division of cost of the Bonneville Dam and power development on the Columbia River near Portland, Ore., has been the first item to receive consideration by the newly created Bonneville Dam Commission. The commission is to report at the next legislative session a program for the development of the full use of Bonneville power. It has been decided to contend for a 50-50 split of the cost as between power and navigation on the ground that the lower the cost allocated to power development the lower would be the power rate that could be established.

The commission consists of two senators and two representatives from the state Legislature and three citizens chosen at large. D. C. Henny, nationally known consulting engineer of Portland, one of the members-at-large, was chosen chairman, and Amedee M. Smith, another at-large member, also of Portland, vice-chairman.

Output Drops From Winter Peak



Continuing the gains compared with corresponding weeks in both of the past two years, by 9.6 per cent over 1933 and 1.3 per cent over 1932, output of central electric light and power stations during the week ended January 27 amounted to 1,610,542,000 kw.-hr., according to the Edison Electric Institute. Production thus far this year has been about 10 per cent greater than a year ago and 11 per cent under the January record established in 1930. Whether or not the decrease during the past fortnight is significant cannot yet be stated with assurance.

Large gains over 1933 continue in the Mountain region. In the South December losses changed to January gains. In the leading industrial regions percentages of the past three months are being surpassed.

Weekly Output, Millions of Kw.-Hr.

1934	1933	1932
Jan. 27...1,611	Jan. 28...1,470	Jan. 30...1,589
Jan. 20...1,625	Jan. 21...1,484	Jan. 23...1,598
Jan. 13...1,646	Jan. 14...1,495	Jan. 16...1,602
Jan. 6...1,564	Jan. 7...1,426*	Jan. 9...1,619
1933	1932	
Dec. 30...1,539	Dec. 31...1,415	Jan. 2...1,524

*Slightly revised from data previously published.

Per Cent Change from Previous Year

	Week ended		
Region	Jan. 27	Jan. 20	Jan. 13
New England	+ 8.6	+10.0	+ 9.2
Middle Atlantic	+ 9.9	+ 9.3	+ 8.6
Central Industrial	+13.1	+13.0	+13.1
West Central	+ 5.2	+ 5.6	+ 8.8
Southern States	+ 7.9	+ 7.7	+10.4
Rocky Mountain	+17.5	+18.2	+19.8
Pacific Coast	+ 2.8	+ 2.0	+ 3.5
United States	+ 9.6	+ 9.5	+10.1

Drumm Battery for Trucks

Recent experiments in driving highway vehicles with the sensationally unusual Drumm battery so thoroughly tested in railway work (ELECTRICAL WORLD, September 2, 1933, page 294) show low operating costs. It is announced that maintenance costs are less than half of those for gasoline-driven trucks and 20 per cent less than for horse-drawn vehicles. Compared with the lead battery it is claimed that the initial cost of the Drumm unit is about the same, while its weight is 40 per cent less. Its life is approximately ten years, against three years for the lead battery.

Neversink River Rights

That three parties are fighting for the right to divert the water of the Neversink River at the Cuddlebackville Dam in the town of Deer Park, Orange County, New York, was disclosed when Justice Frederick P. Close of the Supreme Court granted a motion for a preferred trial on one of the defenses of Rockland Light & Power Company. Both the Water Right & Electrical Company, Inc., and Henry C. McBrair of the White Plains area claim title to rights by deed from the Neversink Valley Water Company and have filed separate suits now consolidated, while the power company claims prior title.

Slump Hits Switzerland; Energy Sales Reported Off

Reports of hydro-electric power output in Switzerland show a considerable drop as a result of the general industrial depression. Thus the Waggital Power Works Company reports 1932-33 sales to have fallen to 107,000,000 kw.-hr., as compared with 142,000,000 kw.-hr. for the preceding twelve months. Sales of the Lontschwerk Company dropped 42 per cent. Part of this was due to the depression and part to a three months shut down early in the year for an overhaul of the 25-year-old equipment.

In view of the reduced demand for power Swiss Federal Railway authorities have decided to modify the construction program connected with the new Etzel hydro-electric power station. The first part will not be ready before the autumn of 1937 in spite of the fact that orders for pipe line and equipment have been given out to Swiss firms to keep men employed.

New Five-Year Plan Seeks 79 Power Plants

Special attention to construction of 79 district power stations of a total capacity approaching 3,000,000 kw. was officially urged at the recent congress of the Communist party of the Soviet Union in adopting a program for the completion of the technical reconstruction of the entire national economy and growth of production of the second Five-Year Plan presented by the State Planning Commission of the Soviet Union. So it appears that electricity will be an indispensable essence of the new Five-Year Plan in Russia.

This would call for the completion of the 558,000-kw. Dnieper River power station and the Svir River No. 1 station now under construction (page 199) and 77 other stations ranging from 60,000 kw. up to the Perm station, planned for 310,000 kw. Some of these projects are new and others mean carrying to completion work already started.

Rapide Blanc Proceeds

Shawinigan Water & Power Company reports its Rapide Blanc development on the St. Maurice River to have proceeded to the point where the dam, power house foundations and other permanent works are completed for all the six units. Work is proceeding on the completion of four units, which will be in operation by early summer. The Rapide Blanc development will ultimately comprise six 40,000-hp. units or a total of 240,000 hp. This installation will give the company a total electrical capacity available of 809,200 hp. and a hydraulic capacity of 55,000 hp., in addition to 110,000 hp. purchased. The cost of the Rapide Blanc development, including interest during construction, will be approximately $14,000,000.

Truck Shipments Rise

December shipments of electric industrial trucks and tractors, as reported to the Bureau of the Census by ten leading manufacturers, totaled 67, as compared with 60 in November, 13 in December, 1932, and 22 in December, 1931. Domestic shipments for the year 1933 were 507, against 237 in 1932 and 529 in 1931. Monthly shipments were much larger in the last seven than in the first five months.

As to Rates—

• Utah Power & Light Company has been served with a complaint by the Public Utilities Commission in the general power rate case, which calls for an investigation of the basis of rates charged by the company and it has been given twenty days in which to file an answer. The complaint alleges that the rates of the company are excessive, its classifications, rules, regulations, practices and measurements with respect to its electrical service rendered in the state are unjust, unreasonable and discriminatory, and therefore unlawful, and in violation of the public utilities act. The commission indefinitely postponed a decision on the petition of the Consumers' Welfare and Research League that affiliated organizations, such as the Electric Bond & Share Company, be included in the investigation (ELECTRICAL WORLD, January 20, page 131).

Street-lighting rates assailed

• Washington Department of Public Works heard street-lighting rates charged by private power companies in 175 cities and towns characterized by its engineers who conducted an investigation as excessive. Using the net earnings of major companies from their street-lighting service as an illustration, James W. Carey, chief engineer of the department, testified that Puget Sound Power & Light Company's rate of return from this source in 1932 was 12.78 per cent, Washington Water Power Company 21.05 and Pacific Power & Light Company 21. Net earnings of smaller companies ranged as high as 65.71 per cent, he said.

• Long Island Lighting Company officers and directors served in the capacity of security sellers, receiving a fee of $2 or $3 a share for selling preferred stock of the company, according to testimony given last week before the New York Public Service Commission in the rate case now before that body, Thomas Booth, assistant auditor of the company, testified.

• Westchester Lighting Company's rates have been defended by Eugene H. Rosenquest, president, in letters to customers as a result of the agitation in Westchester for reduced charges for electricity. According to Mr. Rosenquest the company has five times voluntarily reduced its rates since 1926, with a resultant saving to consumers of approximately $9,000,000. He challenged the statement made by critics that the company's rates were out of line with electricity costs elsewhere.

• Nebraska Gas & Electric Company is charged by Butler County farmers with attempting to perpetuate service charges barred by a law enacted a year ago by a readjustment of rates for initial uses of current. It is charged that rates are exorbitant, illegal and unjustified.

• Kansas Power & Light Company has filed with the State Corporation Commission application for proposed reduction in rates in 57 Kansas cities and towns. The initial cut, if approved, will be effective February 1, 1934, with a second reduction on January 1, 1935, and a third a year later. The reductions on residence lighting rates effective February 1 will total approximately $80,000 annually. Suburban rates are reduced ½ cent per kilowatt-hour, and a new lower schedule for commercial lighting and power has been compiled.

• Syracuse Lighting Company's reduction in charges for residential electric service, saving consumers $119,000 annually, has been approved by the Public Service Commission. The lower rates are effective February 1.

• Tonawanda (N. Y.) Power Company's new schedule of residential electric rates, saving consumers $24,000 per year, has been approved by the Public Service Commission. The lower rates became effective February 1.

• Buffalo General Electric Company and Niagara Electric Service Corporation's residential rate cuts, saving customers of both companies $135,000 a year, have been approved by the Public Service Commission, effective February 1.

• Missouri Public Service Commission reports that users of electricity in that state were given reductions of $2,389,308 in rates during the fiscal year ended December 1, 1933.

Municipal Items

WAGONER, OKLA.—Pending before the state Supreme Court is a suit brought by the Public Service Company of Oklahoma seeking to collect from this city for electricity supplied during 1930 and 1931. The petition filed with the high court declared the city was supplied with electricity after its municipal plant failed. The case previously was dismissed in the lower court when the city's demurrer to the action was sustained.

ATTALLA, ALA.—In a recent city election municipal ownership was turned down by a vote of 269 to 127.

ALBIA, IOWA—February 16 has been set by City Council for a special election to decide on the construction of a municipally owned and operated light and power plant to cost $363,880 and to be financed by a bond issue to be retired from plant earnings.

CONCORDIA, MO.—Suit to test the legality of P.W.A. loans to municipalities to be expended for the construction of municipal utility plants to compete with existing privately owned facilities has been filed in federal district court in Kansas City by the Missouri Public Service Company, which seeks to prevent this city from building such a plant. Recently the city was allotted a federal grant and loan of $47,000 (ELECTRICAL WORLD, January 27, page 163).

BURLINGTON, VT.—On the grounds that a special city meeting was illegally called and that a two-thirds vote was necessary and not obtained 23 plaintiffs, including the Green Mountain Power Corporation, have served a bill of complaint in chancery upon the city to secure an injunction permanently restraining the city from issuing bonds for the Diesel engine project at the power plant (ELECTRICAL WORLD, January 27, page 167).

MILWAUKEE, WIS.—At a recent meeting Common Council placed in the 1934 budget an item of $15,000,000 of revenue bonds with the purpose of applying to the federal government to take over these bonds for the construction of a power plant, and for the acquisition, if possible, of part of the existing distribution system.

CALIFORNIA—By a vote of 506 to 77 northern Calaveras County has created the Calaveras Public Utility District with the purpose of petitioning the federal government for a loan of $210,000 with which to purchase the system and water rights of the Mokelumne River Water & Power Company.

Formation of a series of municipal utility districts in California to distribute water and power developed by the Central Valley Water project was recently advocated by a subcommittee of the State Water Plan Association. The report stated there is at the present time no prospective purchaser of Kennett Dam power except the Pacific Gas & Electric Company, which has said, according to the report, that it would not buy any power from the project. The report recommends the annexation of such areas found necessary for the creation of the new utility districts and the building of competitive distribution systems unless the existing systems can be acquired as part of the project.

NEBRASKA—Resolutions declaring the proposed federal code unfair to municipal interests have been passed by the utilities section of the League of Nebraska Municipalities, representing all municipal plants in the state, at a special session held recently in Lincoln. The league maintains that the code proposed shuts off all future expansion by publicly owned utilities.

FINANCIAL · · · BUSINESS

Arthur Allen Heads Westinghouse Sales

Following a meeting of the board of directors of the Westinghouse Electric & Manufacturing Company, held in New York this week, announcement was made of the election of Arthur E. Allen as vice-president in charge of the merchandising division, which is now established as a separate operation, distinct from other divisions of the company. Mr. Allen, formerly vice-president of the Westinghouse Lamp Company, will have charge of sales, manufacturing and engineering activities.

Savannah Trial Plan for Water Heaters and Ranges

Joining the rapidly growing ranks of those utilities willing to offer unusually attractive terms to get heavy-duty appliances on the line Savannah Electric & Power Company has instituted a trial plan for the purchase of an electric range, water heater, or both. The plan is available to any residential customer connected to the existing distribution system, providing his credit is acceptable and the rules for installing the service desired are applicable. One range and two sizes of water heaters are made available. Any one of the three can be had for trial for a maximum period of one year for a charge of $2 per month and on combination sales the purchase price is unaltered, but the monthly trial charge is reduced to $3.50 per month. Should the customer desire to purchase the equipment any time during the trial period or at the end of the period, all payments are credited on either the cash purchase price or time purchase price.

CONGRATULATIONS

If 300,000 greetings, including 100,000 telegrams, felicitating the President on his birthday and his signing of the dollar devaluation bill, bringing him "the happiest birthday I have ever known," mean anything, America is mightily pleased with the current course of events. As between the apostles of escape and the ascetics of integrity the nation has had little difficulty in choosing sides.

With the intended building of greater confidence in the monetary unit a note of uncertainty creeps back into the tell-tales of business.

Energy production, at a slightly lower total than in the preceding week indicates a leveling out to be probable. Carloadings, up but 0.9 per cent over the previous week, substantiate that view. Steel output, at 34.4 per cent, shows a high point, but only a small gain. Bituminous coal production off 7,300,000 tons in one week. January retail sales up 9 to 30 per cent. Auto production gains sharply. Earnings reports for 1933 are mixed, good and fair, with some startling discrepancies from anticipated figures.

Still to be felt are the results of inconceivably vast government expenditures, made and promised. Since only business profits can pay increased taxes, larger profit margins and greater business volumes must soon be found if the great experiment is to succeed.

Refrigeration Code Sets Policies

IN THE supplemental code for the refrigeration subdivision of the electrical manufacturing industry, revised for a public hearing this week, control of practices and policies is rigidly stipulated. Advertising and sales promotion provisions of the code permit no representation of a character calculated to mislead the uninformed or casual reader to be used and no representation of a negative character. Advertising and sales promotional activities offering products which are not intended to be openly and freely sold, with the object of attracting customers for the purpose of selling other products would be held a code violation.

It is further provided that used competitive apparatus shall not be accepted in partial payment for the products of the industry for sums greater than will be realized in the resale of such used products or apparatus, and allowances made in exchange for such apparatus shall take into account the costs of reconditioning and reselling. Neither direct nor indirect use shall be made of competitive apparatus in connection with sales promotion or advertising. Any advertising or sales promotion which may directly or indirectly create in the minds of the public an erroneous impression of the hazards involved in the use of various refrigerants shall be held in violation of this code.

In connection with a service policy the code states that employers may develop individual plans for providing replacement units in case of complete failure after the expiration of the warranty (one year) providing that amounts no less than $7.50 to $20, depending on the replacement year, shall be billed to the customer and that such amounts shall not be included as part of the selling price of the original equipment, and shall not be billed nor charged for in advance of such replacement.

Minimum down-payments set

Household refrigeration shall in no case be sold without a minimum cash payment equivalent to 10 per cent of the installed price of the apparatus and time payments in connection with such sales shall in no case be extended beyond 24 months unless the unpaid balance exceeds $240. Commercial refrigeration equipment shall in no case be sold without a minimum cash payment equivalent to 20 per cent of the installed price of the apparatus. Interest and carrying charges shall in all cases be collected on deferred payments.

Protests by various representatives of labor against classification of the lighting equipment manufacturing industry as a division of the fabricated metal products manufacturing and metal finishing and metal coating industry marked the public hearing held January 26 on a code of fair competition presented by the Artistic Lighting Equipment Association, which claims to represent more than 77 per cent of the dollar business volume in such products.

National Recovery Administrator Hugh S. Johnson has announced that another session of the reconvened public hearing on the approved code for the electrical manufacturing industry will be held February 8 for the purpose of considering amendments to be offered by the National Electrical Manufacturers Association. Deputy Administrator H. O. King will preside.

Small enterprises protected

President Roosevelt last week signed an executive order to protect small enterprises under NRA by providing that if a complainant be dissatisfied with the handling of his case by any governmental agency he can press his case before the Federal Trade Commission, or if this commission has no jurisdiction to handle the complaint, it is to be referred to the Department of Justice.

Refrigerator Sales of 1933 Totaled 1,065,000 Units

Not content with reporting unit sales in 1933 that exceeded those in any prior year of the industry's history, electric refrigerator manufacturers are planning an at least 20 per cent bigger year for 1934.

According to the Edison Electric Institute 1,065,105 household units were sold last year. In 1932 770,000 were marketed; in 1931, 950,000. Some manufacturers plan as much as a 30 per cent increase in 1934. Possible achievement of 1,200,000 to 1,500,000 sales seems likely.

Dollar Revaluation Holds Bond Coupon Problem

Almost as indefinite as before, the holder of dollar bonds with foreign currency clauses finds his rights little clarified by the recent reports to the New York Stock and New York Curb exchanges (ELECTRICAL WORLD, January 20, page 134). Several American companies, including Pacific Gas & Electric, have indicated revision of their method of payment of interest to remit dollars only to American holders. Some foreign issuers of dollar bonds, including the French, Swiss and Dutch East Indies governments, still pay at old parity.

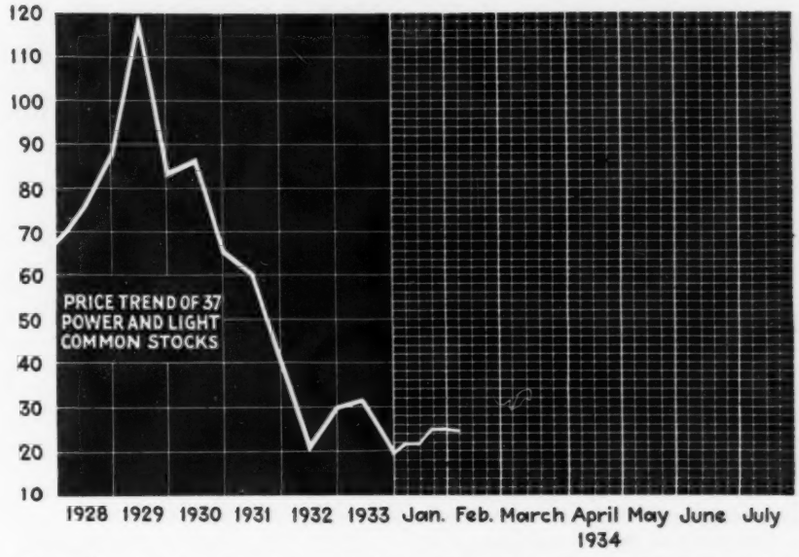
Payments on foreign electric bonds of two issuers that bear optional payment clauses, namely, Adriatic Electric Company and Meridionale Electric Company, payable in Swiss francs or dollars, are reported by bondholders as being met only in dollars. Montreal Light & Power Consolidated, regarding the payment of principal and interest on its 5 per cent bonds, series A, due October 1, 1951, and 40-year sinking fund 5 per cent first refunding and collateral trust gold bonds, series B, due March 1, 1970, has reported that it has not as yet limited the bondholder's option as regards servicing these bonds in any way. The firm also reported similarly on the first mortgage 5 per cent gold bonds due January 1, 1953, of Cedar Rapids Manufacturing & Power Company.

Courts in this country have not yet established the rights of American holders of foreign dollar bonds, payable in multiple currencies, nor the rights of foreign holders of American bonds of this type. Neither has there been any decision on the rights of American holders of bonds of any description containing a clause guaranteeing payment in gold.

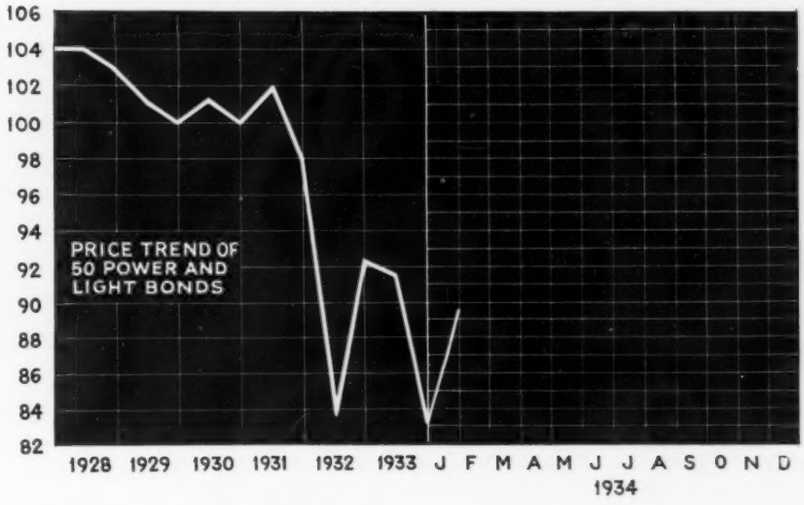
Central States Hearing

Further hearing on the reorganization plan for the Ceneral States Edison Company, in receivership, has been postponed by Chancery Court in Wilmington, Del., until February 21, by which time the first lien bondholders' protective committee of the corporation expects to be able to submit its reorganization plan. The committee a month ago entered objections to a reorganization plan submitted by Fred J. Young and Ivan Culbertson, receivers for the corporation. The receivers and the committee are to endeavor to agree on a plan satisfactory to both.

Sharp Revival in Securities



Responding to the upward surge in all security markets as the dollar devaluation plan became an actuality, light and power common stocks in the "Electrical World" average rose to 25.0; last week 24.6; a month ago 19.6. Utility bonds, last month at 83.3, achieved 89.8.



G. E. Shareholders Increase

Closing its books at the end of 1933 with 188,316 shareholders listed, General Electric reports the largest number of owners in its history. This is an increase of a little more than 7,000 for the year, the number of stockholders at the end of 1932 having been 181,310. At the end of 1931 there were 150,073; at the end of 1930 there were 116,750. The increases for each of these years were: 1931, 33,323; 1932, 31,237; 1933, 7,006.

Empire Assets Sold

Subject to confirmation in Chancery Court this week, the assets of the Empire Public Service Corporation were sold to the highest bidder at public auction in Wilmington, Del., last week by the firm's receivers.

Associated Plan Gains

More than $125,000,000 of the $260,000,000 outstanding debentures of the Associated Gas & Electric Company, or 48 per cent of the total, are reported by the company to have been exchanged under the plan of rearrangement of debt capitalization. Approximately 50 per cent of the 100,000 holders have deposited their debentures.

Colorado River Project Protested by Arizona

Having contracted with the United States Bureau of Reclamation to build a dam on the Colorado River near Parker, the Metropolitan Water District of Southern California has declined to recognize objections to the project by the State of Arizona. In a letter to Gov. James Rolph, Jr., of California, Gov. B. B. Moeur of Arizona stated that he had learned that the district had procured the allotment of federal funds with which to initiate the construction of the dam, which, if built, would in part be placed upon Arizona soil. Insisting that an agreement safeguarding the state's proper rights and interests should be made, Governor Moeur said that according to the opinion of the Arizona Attorney-General the dam cannot be built without Arizona's consent.

Construction of the dam is out of the hands of the district and under the absolute control of the Bureau of Reclamation, in the opinion of Ray Bruce of the water district's legal staff. "The department has contracted with the district to build the dam," he said, "the entire cost to be repaid to the government by the district. The government will own the dam and control it. . . . Arizona is guaranteed many benefits under the contract . . ."

•

Foster Wheeler Gains

Predicting that the annual report, not yet issued, would show 85 to 90 per cent more orders booked in 1933 than in 1932, John J. Brown, president of the Foster Wheeler Corporation, last week reported the company's outlook to be distinctly better. "Prices are better," Mr. Brown said, "and our bookings are improving. December, which for us is normally a bad month for bookings, was very good, and January is going to be the best month we have had in nearly two years. February looks better. . . ."

•

Kelvinator Orders Rise

Orders received by Kelvinator Corporation during the first half of January were 200 per cent greater than for the same 1933 period, according to George W. Mason, chairman of the board and president. For the last quarter of 1933 orders were 150 per cent of the corresponding 1933 period. Net loss for the last 1932 quarter was reported as $341,035, which compares with $330,193 in 1932.

St. Lawrence Ratification Urged by Roosevelt

Again expressing his interest in the St. Lawrence waterway project, President Roosevelt last week sent the joint report of the Federal Power Commission and the Power Authority of the State of New York to the Senate, where the treaty providing for co-operative development of the St. Lawrence River by the United States and Canada is awaiting ratification (ELECTRICAL WORLD, January 27, page 164.) "The primary purpose of New York State in creating the Power Authority to undertake this power project," the report stated, "is to secure for domestic and rural consumers of electricity rates which will make possible such use. The development of St. Lawrence power under this public agency represents the last opportunity available to provide the northeastern section of the country with the benefits assured other sections through the development of Muscle Shoals, Boulder Dam and the Columbia River."

To add 900,000 hp.?

Engineers who prepared this report estimated that generating capacity projected for the American side of the power site could produce a potential 6,000,000,000 kw.-hr. of electricity annually, or 769,562 hp. of primary energy and 141,798 hp. of high-grade secondary power. It was estimated that this entire output could be used in New York State alone with only a 20 per cent increase in the demand for generating capacity in the next seven years. According to the report, analysis of the relationship between power development and growth of industry in other regions shows that the installation of 1,100,000 hydro-electric horsepower on the United States side of the St. Lawrence River is likely to bring with it investment of more than $500,000,000 in new industries, with employment for some 80,000 additional factory workers and a corresponding increase in population and in all lines of economic activity, including rail transportation of raw materials and consumer goods.

•

Electromaster's 1933 Good

According to President R. B. Marshall of Electromaster, Inc., that company's 1933 business in electric ranges exceeded 1932 by 50 per cent. Shipments in January ran well ahead of those in the same month last year.

New York Metal Prices

	Jan. 23, 1934 Cents per Pound	Jan. 30 1934 Cents per Pound
Copper, electrolytic	8.375	8.25
Lead, Am. S. & R. price	4.00	4.00
Antimony	7.20	7.15
Nickel ingot	35.00	35.00
Zinc, spot	4.65	4.60
Tin, Straits	51.50	51.50
Aluminum, 99 per cent.	23.30	23.30

Major New Construction This Week

Northern States Power Company, Minneapolis, Minn., has authorized $160,000 for a 33,000-volt transmission line from vicinity of Jim Falls to Chetah, Wis., and plans early construction.

Great Southern Distilling Company, New Orleans, La., will remodel plant at cost of $115,000.

Bureau of Reclamation, Denver, Colo., asks bids until March 9 for seven 55,000-kva., single-phase transformers and four 13,333-kva., single-phase transformers, also two 3,000-kva. generators, complete with auxiliaries, for Boulder Dam power plant, Boulder Canyon project (Specification 565).

Niles, Mich., plans extensions and improvements in city-owned electric light and power plant, to cost $325,000.

Heavy-duty motors, controls, regulators, conveyors, etc., will be installed, to cost over $70,000, for Tulsa Steel Corporation, Sand Springs, Okla.

Roaring Fork Electric Light & Power Company, Aspen, Colo., plans transmission line from Aspen to site of new Taylor River conservation dam, at cost of $100,000. Contract for power supply secured.

Motors, controls, conveyors and refrigerating machinery will be installed in new $65,000 cold storage plant of Windham County Fruit Growers' Association, Brattleboro, Vt.

Augusta Canal Commission, Augusta, Ga., plans hydro-electric power plant to cost $2,500,000, with power dam, transmission lines, power and switching stations, and other structures. Fund of $1,500,000 planned.

Motors, controls, conveyors, electric hoists, etc., will be installed by Riverbank Canning Company on 10-acre tract at Stockton, Calif. A $250,000 project.

Henderson, N. C., plans new $34,000 street-lighting system in business district and other sections, through federal aid.

Leonard to Spur Sales

That the largest advertising, sales and promotion program in the Leonard Refrigerator Company's 53-year history will be launched this year was announced this week by Godfrey Strelinger, sales manager. A series of 40 dealer-meetings in key cities from coast to coast will be held.

Servel Reduced Loss

Reporting a loss for the fiscal year ended October 31, 1933, of $493,399, as compared with a net loss of $777,443 in the previous year Servel, Inc., has announced the discontinuance of its Hermetic line of electric household refrigerators because of insufficient sales volume. The machine tool and plant changes chargeable against such production have been liquidated.

MEN OF THE INDUSTRY

P. L. Smith Succeeds J. H. Gulick in Chicago

Purcell L. Smith, an executive of the City Company, Inc., of New York, has been elected vice-president in charge of finance of the Commonwealth Edison Company and the Public Service Company of Northern Illinois to succeed John H. Gulick, who retired on February 1 because of ill health. A native of Chicago, Mr. Smith was connected with the North American Light & Power Company and its subsidiaries in that city from 1916 until 1929, when he went to the City Company of New York. Mr. Gulick first became associated with the Commonwealth Edison Company in 1898, but remained only a year. He returned to the company in 1905 as auditor and was elevated to the rank of vice-president in 1914, the office which he has held since. He was connected with the Public Serivce Company from the time of its organization in 1911.

•

ERIC N. NELSON, formerly engineering assistant of the Ohio Public Service Company at Massillon, has been appointed distribution superintendent at Ashland.

HENRY F. YOST, for the last eighteen years Pacific Coast manager of the Trumbull Electric Manufacturing Company, resigned from that position January 1.

JOHN J. BROWN has been elected president of the Foster Wheeler Corporation, New York, to succeed the late L. B. Nutting. Mr. Brown retains his position as chairman of the board, which he has held since 1927.

M. J. FOX, for 21 years connected with the Columbus (Ga.) Electric & Power Company as purchasing agent, has been appointed head of the purchasing department of the C.W.A. organization in Tennessee and has left for Nashville, where he has entered upon his new duties. Mr. Fox is one of the best-known purchasing agents in the Southeast.

GERALD HULETT, sales manager of Electromaster, Inc., has been elected vice-president and a director of the company. Mr. Hulett's association with Electromaster dates back to 1930. As a member of the sales staff, he established and developed the company's organization in its New England territory. A year later the management withdrew him from the field for the broader opportunity as manager of the sales promotion department. In 1933 it placed all sales directly under his charge, including the new development under the trial and rental method introduced by Electromaster in January, 1933. The duties of general sales manager will still be actively shouldered by the new vice-president.

MARK ELDREDGE, chief engineer for the Memphis Power & Light Company, has been elected president of the Memphis Engineers Club for the year 1934.

MARVIN H. MCCALLA, vice-president and general manager of the Foxworth-McCalla Lumber Company, was appointed a director of the Verde River Irrigation and Power District at special session of the board held recently in Phoenix. He replaces E. W. Michael, who resigned from the board to become manager of the district.

C. S. BOWDEN, formerly distribution superintendent of the Ohio Public Service Company at Ashland, has been transferred to Alliance in the same capacity.

F. U. WEBSTER, advertising manager of Cutler-Hammer, Inc., Milwaukee, for the past seven years, has been named manager of merchandising sales for that organization. In his new capacity Mr. Webster will have charge of all sales to jobbers and dealers.

OWEN D. YOUNG, chairman of the board of directors of the General Electric Company, has resigned as chairman of the board of trustees of St. Lawrence University, Canton, N. Y., effective at the end of the academic year in June. For the past ten years Mr. Young has served as chairman of the board and has been the guiding force in expanding and enlarging the university. Upon his retirement as chairman he will become honorary president of the board of trustees of St. Lawrence.

FRANCIS X. FITZPATRICK, who has been identified with the Graybar Electric Company, Inc., for more than twenty years, has been appointed sales manager for the New England territory.

WARREN W. LOOMIS, general purchasing agent for Stone & Webster from 1917 to 1933, has been appointed superintendent of supplies for the city of Boston and will be in charge of all purchasing for the municipality. Mr. Loomis was graduated from the Massachusetts Institute of Technology in 1905 from the electrical engineering course. For three years he served as purchasing agent and superintendent for Stone & Webster in the Dallas Electric Company in Texas, returning to Boston in 1909 to join the purchasing staff of the firm, and gradually rising to the post of department headship. He is a resident of Needham, Mass.

ROBERT F. MCDONALD, sales manager of the San Francisco district, has been made vice-president and general sales manager of the Westinghouse Electric Supply Company of Northern California.

J. R. HALLADAY, formerly distribution superintendent at Alliance, Ohio, for the Ohio Public Service Company, has been appointed division manager of the company at Ashland to succeed S. R. Finley, resigned.

L. P. NIESSEN, formerly assistant advertising manager of Cutler-Hammer, Inc., Milwaukee, will assume direct charge of advertising for the company following the appointment of F. U. Webster, formerly advertising manager, to the position of manager of merchandising sales.

RICHARD B. MARSHALL, who has been general manager and vice-president of Electromaster, Inc., was unanimously elected to the presidency of the company at the annual meeting of directors and stockholders in Detroit on January 23. Mr. Marshall has been associated with Electromaster since its inception. Today he is recognized as an engineering authority in the electric range industry, exhaustive investigations during recent years carrying him as far as England and the Continent. He will continue in the active management of the company.

OBITUARY

HENRY BAUM, JR., vice-president and sales manager of Adam Cook's Sons, Inc., Linden, N. J., died January 20.

A. BURTON CHAMBERLAIN, assistant superintendent of the station engineering department of the Boston Edison Company, died at his home in Wollaston, Mass., January 22. He was born at La Crosse, Wis., 58 years ago and had been in the employ of the company for 30 years, mainly in engineering capacities.

FRANCIS A. VAUGHN, president of F. A. Vaughn, Inc., consulting engineering firm with headquarters in Milwaukee, Wis., died January 23 in his sixty-third year. Mr. Vaughn was prominently identified with the electrical industry for a number of years.

He entered this field in the wiring and contracting branch in 1893 and after obtaining practical experience in this business and with certain electrical manufacturing companies he entered the electrical engineering department of the Milwaukee Electric Railway & Light Company, remaining with this organization for fourteen years. During his association with this utility he passed by successive stages through power house operation, superintendent of meter and testing departments, in charge of all designs, estimates and specifications of all electrical improvements, electrical engineer for lighting department, his work embracing practically every phase of low-tension and high-tension direct-current and alternating-current construction, generation and transmission. Since 1910 he had been in the consulting engineering field. In addition to carrying on his consulting practice, Mr. Vaughn was active in professional society work in the American Institute of Electrical Engineers, of which he was a fellow, the Illuminating Engineering Society, the National Electric Light Association and in the work of many Wisconsin engineering associations.

AMANDUS PHANEUF, one of the thirteen original founders of the Thomson-Houston Electric Company, died recently at Lynn, Mass., after 47 years of service with that organization and its successor, the General Electric Company. He retired from active business several years ago.

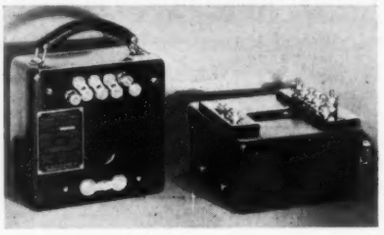
JOHN H. MORECROFT, professor of electrical engineering at Columbia University, New York, died in California January 26, after a brief illness. Professor Morecroft was on leave this term, but was scheduled to resume his regular work early in February. A native of Staffordshire, England, he migrated to the United States as a young boy, and following graduation from Syracuse University, he joined the teaching staff of his alma mater as instructor in both civil and electrical engineering. Subsequently he became instructor in electrical engineering at Pratt Institute, Brooklyn, N. Y., in charge of the laboratories of the department of applied electricity. In 1907 Professor Morecroft began to study under Prof. Michael I. Pupin and in 1909 he was appointed instructor in electrical engineering at Columbia University, four years later having been promoted to the rank of professor. He was a past-president of the Institute of Radio Engineers and served on many committees of that association and of the American Institute of Electrical Engineers. Professor Morecroft was best known for his works on radio communication, but he also published books on electronics, electrical circuits and machinery.

NEW EQUIPMENT

Portable and Compact Current Transformers

With the portable current transformer, for use with indicating and recording instruments, recently developed by the Esterline-Angus Company of Indianapolis, Ind., nine primary current ranges may be utilized. Primary currents are 10, 12.5, 25, 50, 100, 160, 200, 400 and 800 amp.

The volt-ampere rating is 25 and the transformers are compensated for a



load of 15 volt-amperes, which enables the transformer to operate several instruments simultaneously at high accuracy. The insulation is for circuits up to 2,500 volts. The containing case is cast aluminum to withstand rough usage, and after assembly all moisture is removed from the windings and case is filled with an insulating compound which makes it safe for use in mines, manholes and damp places. The weight is 28 lb. Special sheet steel is used in the cores and they are so proportioned that ratio and phase-angle errors are low.

•

Line Protection Gaps

Expulsion-protective gaps for the prevention of line insulator flashover are now supplied by the General Electric Company for systems from 13.8 to 230 kv. as lightning-discharge devices that combine the principles of the plain discharge gap and an expulsion fuse. Long operating life, simple installation for any type of new or existing transmission line, small size and weight and low first cost are some of the claimed advantages. Tests in several years service indicate rapid functioning with no noticeable lamp flicker. Their performance does not depend on low-resistance grounds. They are said to increase the margin of safety of system stability.

The gap consists of a weatherproofed lacquered fiber tube, with an electrode at each end and open at the lower end. Sparkover occurs across a gap between the electrodes within the tube and the attendant power-follow current creates a high pressure within the tube which expels the arc vapors, thereby interrupting the short-circuit power current in the first half cycle, before relays and circuit breakers can operate.

•

FITALL FUSE LINKS designed for use in all standard makes of open-type fuse switches, closed-type cutouts and self-releasing cartridge switches and cutouts have been announced by the James R. Kearney Corporation, St. Louis, Mo. All links are 26 in. long so they are usable in open-type switches of 15,000-volt rating or under. The tail or the link can be cut to the proper length for lower voltages and the links have a terminal arrangement adaptable to button-head or side-type cartridges. The weak section support is of spring and fiber tube construction for below 25 amp. in expulsion equipment, and usual strain wire support for tension equipment above 20 amp. rating.

Manual Voltage Adjuster

Variable-voltage adjuster, as offered by the Acme Electric Manufacturing Company of Cleveland, Ohio, involves a manual regulating device which permits the adjustment of supply voltage from either below or above normal to the rated operating voltage of appliances. It is designed to give proper voltage for radios, refrigerators, small

motors, etc., to insure normal performance where voltage is too low and to prevent damage to radio tubes, condensers and small motors from over-voltage.

In construction and appearance the regulator is similar to an ordinary stepdown transformer. The manually operated dial control gives results indicated by an accurate voltmeter. It may be used for shop service to test appliances and motors at low- or over-voltage.